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PLANNING THE LAND OF GREAT BRITAIN

THE Bill introduced in the House of Commons by the Minister of Town and Country Planning is clearly a minor measure in fulfilment of a promise made by Lord Reith in the House of Lords in 1941 when announcing the Government's acceptance of the interim report of the Uthwatt Committee. Under this Town and Country Planning (Interim Development) Bill, planning control is to be extended to all areas in England and Wales not already subject to control; it will implement the recommendation of the Uthwatt Committee that no building or development should be permitted which is likely to be prejudicial to the programme of reconstruction that has still to be worked out.

While in this Bill, for the first time, England and Wales are visualized as a unit and planning is conceived on a national scale, including London, the measure is scarcely more than negative in character and its scope is limited. Moreover, it must be remembered that, of the half of the nation's land already covered by plans or planning resolutions, only about 6 per cent is under effective planning control. This position is due to the procedure under the existing Planning Acts being all but prohibitive, administratively and financially. The final Uthwatt Report proposed to break this deadlock by providing a solution to the problem of compensation for values disturbed by planning. Until either those recommendations or others designed to achieve the same result are adopted as official policy, the planning of the use of the land will remain an aspiration only. The obstacle presented by the difficulty of compensation is a fact that cannot be set aside or shelved, and until some proposals for dealing with it are adopted in official policy, plans for building and developing a better Britain are meaningless.

The weakness of the Government's present position was well shown in Mr. Ernest Brown's address to the National Housing and Town Planning Council in March. The one difficulty he shirked was the delay of the Government in making these vital decisions, without which neither town nor country planning is possible. Local authorities can make no plans until they and the owners and users of the land know what the principles of control are to be, and how public and private interests are to be reconciled when they come into conflict. Without that, even the emergency building and housing suggested by Mr. Brown is likely to be unsatisfactory and to conflict with the requirements of a national policy.

In housing, as in other fields, no thorough or systematic preparation for post-war developments is possible until the Government has announced its long delayed decisions on the Barlow, Scott and Uthwatt Reports. The machinery is important enough—and a debate in the House of Commons just before Easter showed there is still confusion on that score—but the vital point is that the Government should indicate its broad lines of policy, for these must determine not only the extent and nature of the plans, but also to some extent the nature of the machinery by which

the declared policy is to be implemented. Sir William Jowitt's answer gave a reasonably clear outline of the procedure by which reconstruction policy is discussed and made in the War Cabinet, from the departmental level, through the two sub-committees of the War Cabinet, one of Ministers with Sir William Jowitt as chairman, and the other a special Ministerial committee set up to consider and co-ordinate departmental plans for implementing details of the Beveridge Report, to the Cabinet Committee sitting under the Lord President of the Council, which is concerned with major matters of home policy.

The outline suggests that if there is a Minister of Planning, in the sense of one with a final responsibility for the reconstruction projects upon which the Cabinet must decide, he is the Lord President of the Council, Sir John Anderson, and the adequacy of the existing machinery of government for this purpose could be very well defended up to a point. It does not, however, cover those more fundamental issues of the machinery of government in a democratic State, the balance between central, regional and local administration, which are inherent in the planning of a free society.

What is even more vital at the present time is that the machinery should be used to formulate, announce and implement the basic policies. Continued failure in this respect to adduce the proof of preparedness brings the whole present apparatus of government into disrespect to an extent which may even handicap the war effort. This danger can be clearly seen in a broadsheet "Plans for Physical Reconstruction" issued by Political and Economic Planning last December, in which the most important recommendations of the Barlow, Scott and Uthwatt Reports are summarized, the action already taken indicated, the issues still remaining for decision described, and some of the wider implications of the movement for physical planning indicated. A subsequent broadsheet issued in April, "After the Beveridge Report", reviewing some of the chief problems raised by that report, makes a similar valuable contribution to the appraisal of various aspects of Sir William Beveridge's proposals.

The Barlow, Scott and Uthwatt Reports are all concerned with the physical planning of Great Britain, but from different angles, and in effect they all agree that the nation can no longer afford to allow the 'free price and market' mechanism to act as the chief regulator of the uses of the land, the location of industry, and the growth and decay of towns and cities. The market mechanism itself needs to be regulated and overriden, when the public interest requires, by a public planning mechanism which takes into account all the wide considerations of social, economic and strategic policy ignored by the market. While much of this detailed planning must be worked out and decided by local planning authorities, the three reports also agree that major decisions as to the use of land and the location of industry must be taken nationally by some kind of central planning authority, which can fit local planning schemes into a consistent national development plan and co-ordinate the work of all national agencies concerned with particular aspects of the use of land and industrial location.

Such agencies are only instruments for giving effect to those parts of a wider national policy for social and economic development which fall within their sphere of action. However the instruments of control are constructed, there must therefore be, as the Uthwatt Report insists, "means by which the requirements of agriculture, transport, public services and defence, as well as housing, industrial location, town siting and other matters can be given proper weight and considered as a whole". With the nature and structure of this central machinery we need not be further concerned at the moment: obviously it must be designed to afford some solution to that question of private enterprise and public control on which Mr. Herbert Morrison and Sir Percy Harris have spoken trenchantly; and although the structure of the central authority for control of land and town and country planning has been the subject of much controversy, as indeed the three Reports indicate, its structure must be in harmony with that of the main machinery of government established to serve the needs of a democratic State in the post-war world.

Sir William Jowitt has indicated the Government's view of the paramount importance of the fullest measure of direct responsibility, but at the same time a new permanent commission with more limited functions may be attached to the new Ministry, because it would be the most appropriate body in connexion, for example, with the acquisition of development rights, while it might also be charged with the management of property and similar duties. The new Bill will strengthen the powers of local planning authorities and give them much wider and simpler powers for the compulsory acquisition of land. Lord Portal agrees that the number of local planning authorities is excessive and must be reduced, and he is encouraging them to combine to set up joint planning committees covering wide areas. He is also preparing to make available to local authorities the services of expert planning officers with headquarters in convenient centres; but it is not yet clear whether the Government is prepared to accept the Scott Committee's recommendation that the major local planning authorities should be the councils of counties and county boroughs, or a combination of local government units of equivalent importance. Effective planning of urban re-development also requires decision in the 'reconstruction areas' which are to be developed as wholes, while even a rationalized system of local planning units with reinforced powers and clearly defined tasks requires the support of national funds for the development programmes and to overcome the compensation – betterment obstacle.

That is the main reason why decision on policy is at the moment of primary importance, rather than the machinery by which policy is to be executed, and on this very issue the Government is still considering the Uthwatt Report. That report recommends one approach for built-up areas and another

for the rest of the land. For existing town areas, strengthening town planning powers to ensure really effective public control of development or re-development is recommended. For land remaining in private ownership, compensation would continue to be paid; but to offset this the Uthwatt Committee suggests that when such land is benefited by public planning, betterment should be recouped by a periodical levy.

If the development rights scheme is adopted, controversy over the proposed basis of compensation appears to be inevitable. Another controversial issue is whether, under the development rights scheme, it would be automatically necessary—as the Uthwatt Committee assumes—to acquire publicly all land needed for approved private development schemes. It may well be wise to postpone as long as possible the consideration of nationalization of the land if our objective can be achieved by more elastic methods under a comprehensive central policy adapted for change with changing conditions. Given also wise control and efficient persons entrusted generously with responsibility for local action, the issue between private and national ownership may become insignificant, as the measure of co-operation secured in such ways by the Ministries of Food and of Agriculture seems to show.

Whatever ultimate decisions are taken on these questions, larger problems loom in the background. The scale and pace of the post-war building have still to be decided, and agricultural housing is not alone in forcing the issue. The Ministry of Works and Planning, which is working on the supply problems involved, must balance housing demands against the demands for other types of constructional development. The whole building programme must then be translated into programmes for the use of land, labour supply and raw materials. Moreover, the physical plan has to be integrated with wider social and economic plans. The total demands of physical reconstruction on Britain's resources require balancing against other conflicting demands—those of the export industries, of agriculture, of the Beveridge plan, of consumers for consumers' goods, and of other countries needing assistance in rehabilitation.

From this angle alone it is essential for the Government to define more clearly its attitude both to the Barlow Report and to the Beveridge Report. Again, policies for national planning of the land, urban redevelopment, balanced regional economic development and redistribution of industry and population, ultimately require provisional national objectives for the balance to be aimed at between urban and rural life, and for the related, but by no means identical, balance between industry and agriculture. Acceptance or rejection of the Scott Committee's plea to make the countryside prosperous solely by maintaining a prosperous agriculture will be determined by the decisions on such issues.

These problems extend far beyond the scope of any single Ministry, and they demand a great deal of creative and constructive thinking and research. A Ministerial Committee working on such problems would almost inevitably grow into the Cabinet's chief organ for framing general social and economic planning policy in its major aspects. Any such development could scarcely fail to make an expert social and economic 'general staff' for planning imperative, the need for which should already be obvious when the most cursory attempt is made to survey the vast range of interdependent problems involved.

ECONOMICS AND POLITICS IN THE SOUTH SEAS

The South Seas in the Modern World

By Prof. Felix M. Keesing. (Institute of Pacific Relations: International Research Series.) Pp. xv+391. (London: George Allen and Unwin, Ltd., 1942.) 16*s.* net.

THIS book, in the author's own words, "attempts to define comprehensively the political, strategic, and economic role" of the South Seas in the world to-day. It is written in the manner of a general introduction for the non-specialist reader to a part of the world on which information is not easily available; but in order to produce it Dr. Keesing has drawn, not only on his own extensive travels, but also on a wide range of literature, including unpublished first-hand accounts, and the specialist too will find in it valuable fresh data.

After an introductory chapter describing the geographical setting of the islands and their internal and external communications, and concluding with a section on recent political developments which has unfortunately become out of date between the publication of the book in the United States and its appearance in Great Britain, Dr. Keesing goes on to discuss their economic potentialities and commercial relations with the outside world. In only three groups, as he points out, does trade with the metropolitan Power form a significant proportion of total trade—in Hawaii, the Japanese mandated area, and the Cook Islands. As significant economic trends in the period since the War of 1914–18 he notes the decrease in the number of white small-holders, the increase in production by native communities and by large-scale enterprises, and the marked growth of economic nationalism.

The short section on population is welcome as a corrective to the mystical ideas about the causes of depopulation in the South Seas that have gained wide currency. Dr. Keesing quotes the observations of field-workers who have tested Rivers' theory that native populations die out from loss of *joie de vivre*, and found it inadequate, and gives the statistics now available which show that in many areas the trend has been reversed.

A description of the characteristic reactions to culture contact leads on to a discussion of "alternatives in native policy", in which the American aim of rapid Westernization is contrasted with the British preference for a more gradual development. This divergence of views may have great significance for the future of the dependent areas in the Pacific, particularly if it is interpreted by American public opinion as a contrast between active trusteeship and neglect. It is of interest to learn from Dr. Keesing that "the wisdom of high-pressure assimilation has been questioned in the last few years". A fuller discussion of this point might have been valuable in a

book intended to inform the general public on the problems of the South Seas; but the author could not have foreseen how urgent the question would become.

In discussing government and leadership, Dr. Keesing gives the impression of being hampered by the need to reduce a very complex variety of native political systems, with their corresponding problems of administration, to a few broad generalizations, and he uses phrases which must puzzle the layman and are even hard for the specialist to interpret. Systems of life in Polynesia were "oriented towards localism and warfare". In Samoa a "tendency towards desiccation" has resulted in the splitting of titles and the privileges going with them between numbers of persons, but this has been stopped—how ?—by the American naval authorities.

Dr. Keesing is too kind to the British Colonial Office in coupling it with that of the Netherlands as having "led the way in requiring their administrative staffs to receive special training". In this respect Britain is behind France, Belgium, and her own Dominions.

Land tenure is another subject where it is difficult to describe in generalizations the complex problems arising over this wide area. The point is made, however, that in many dependencies the best land is now in non-native hands, and that the native areas, though apparently extensive, are no longer sufficient where populations are increasing.

In the South Seas the indirect disruption of native economic systems by the drain of young men to centres of employment has probably been less than it has in Africa, but deliberate interference with native usages which are thought by administrative authorities to be wasteful of time or resources has been much greater, and has been, as Dr. Keesing puts it, "a potent source of trouble". He explains the difficulty of inducing native communities to improve their production, in the sense of increasing its cash value, by the fact that "it carries the people concerned beyond what their real wants and tastes dictate". He notes the disorganizing effects that can be produced by a sudden influx of money in an unsophisticated community, and the still greater disorganization that can result when such a community has been persuaded to become dependent on the world price of a single commodity.

The section on health and medical work brings together much interesting and not easily accessible material. The work of the Suva Central Medical School in training native practitioners for work in a number of British and American dependencies, as well as the New Hebrides, is an encouraging example of Anglo-American co-operation. The School was organized by Dr. S. M. Lambert, a representative of the Rockefeller Foundation, and financed jointly by the Foundation and the administrations concerned.

The important part which Christian missions can play in "the stabilization of the changing native life" is emphasized. This involves a thorough knowledge of native institutions and a sympathetic appreciation of their meaning to the native, and Dr. Keesing notes that at the University of Sydney more than seventy missionaries have gone through the same course of training that is given to cadets in the Australian administrative services.

After a section on education there is a tantalizingly short account of the various non-native groups and their problems—Chinese, Japanese, Indians, other migrants and mixed bloods. Dr. Keesing stresses the importance of this last group and their potentialities for constructive leadership, if they are successfully integrated into the community, as well as the dangers of neglect and discrimination against them.

If events have rendered his concluding prophecies out of date, there will be general agreement with Dr. Keesing's insistence that the fullest knowledge of the facts is essential for the solution of the problems of this area, and that specialist investigation should be utilized wherever possible.

LUCY MAIR.

APPLICATIONS OF ELEMENTARY MATHEMATICS

A Source Book of Mathematical Applications

Compiled by a Committee of the National Council of Teachers of Mathematics. (National Council of Teachers of Mathematics, Seventeenth Yearbook.) Pp. xvi+291. (New York: Teachers College, Columbia University, 1942.) 2 dollars.

THE object of this book is perhaps best explained by a few quotations from the introduction. "To see how a principle is applied is to acquire better understanding of its meaning. To know that a principle can be used enhances the value of learning it. Teachers endeavor to make the study of mathematics meaningful and fruitful by exhibiting this utility. . . . No teacher can hope to be cognizant of all the ways in which mathematics is being used, or to know where to find them. To meet the need for a broader knowledge of direct application this volume has been prepared. . . ."

The book is divided into four sections: arithmetic, algebra, geometry, trigonometry; it covers secondary school mathematics up to and beyond school certificate stage. Each section is divided into subsections according to mathematical topic, and in the sub-section the order is that of the field of human activity. Alphabetical arrangement of topics corresponds to a decimal numeration of the entries. The book is intended for reference, rather than for continuous reading, so that an extensive index is provided. Reference here is to the section and number of the entry, but in the page heading neither the section nor (even the leading figure of) the number appear, so that one must glance at the body of the page to see, first that one is in the correct section, and then whether to turn forward or backward. One does, however, soon become familiar with the layout and able quickly to find one's way about.

The entries are very uneven—as the compilers frankly realize. Practically every relevant contribution received has been used, and mostly as supplied. We thus get in some cases little more than vaguely descriptive suggestions, but in others a wealth of numerical or graphical data and sample problems making use of it. Mostly, however, information is supplied and the construction of class exercises is left to the teacher. Teachers in search of realism will be very grateful for the compilation.

One is tempted to use the index to discover where mathematics impinges most on real life. The topics occupying most space in the index are, in order: daily life (a very miscellaneous category), aviation, automobiles, engineering (special technical engineering applications are omitted, as this field is covered in a previous volume), mechanics tieing with

astronomy; agriculture comes next, with but half the space devoted to astronomy, while business and finance occupy little space. If this distribution of topic does not indicate any marked difference between American and British interests and ways of life, there is a pronounced American flavour about many of the entries and the language in which they are described. There are some curiosities among the applications, while others raise queries not always mathematical.

Running down the index, one soon encounters: "Beauty Culture—*see* Cosmetology". Following instructions, one is directed to T 7·01, meaning problem 1 in subsection 7 (sine curves) of trigonometry. Here one finds an excerpt from the *American Hairdresser* and one reads (no, *not* a Fourier analysis of a permanent wave, but) a disquisition, illustrated with squiggly diagrams, upon the stimulating effects of 'oscillating' (a distinction is drawn between 'oscillating' and 'alternating') electric currents as affected by differing wave form. A well-known approximate formula for the perimeter of an ellipse is "used by permission of the Chevrolet Division of General Motors Corporation", who use it to find the perimeter of the section of a gear lever. Why? A1 1·19 gives a formula by which the day of the week corresponding to any date may be determined. On p. 297 is an elegant "Sketch showing Principles of Installing Traffiscope on Hill"—whereby a motorist can see the road for some 1,000 ft. beyond the summit. Are Traffiscopes common in the United States? And so on—but the bulk of the book is straightforward, useful and usable material for the teacher of mathematics.

W. G. BICKLEY.

PROGRESS OF ARMY MEDICINE

War and Disease

By Dr. Ralph H. Major. (Advancement of Science Series, No. 3.) Pp. 190+8 plates. (London: Hutchinson's Scientific and Technical Publications, n.d.) 12*s.* 6*d.* net.

WAR has always been more interesting than disease to the historian, and medical matters received little attention in early chronicles unless they had a very definite bearing on the outcome of the struggle. Medical men have always followed armies but often for educational rather than humanitarian purposes, and only comparatively recently have organized military medical services been evolved.

Dr. Major has outlined the progress of army medicine from the earliest times to the present day, recording as he goes the influence of disease on individual campaigns and on history in general. Plague and typhus were rife in Greece, and particularly in Athens, in the Peloponnesian War between Sparta and Athens. In the second century A.D. Roman soldiers who had fought the Parthians imported smallpox from Mesopotamia, and this epidemic, which lasted fifteen years, spread through Italy and the Roman Empire, and may have contributed to the downfall of the Romans. The Crusaders, whose habits and morals were generally lower than readers of Scott would imagine, suffered from scurvy, and were responsible for an increase in leprosy in Europe. One fine thing did emerge from the Crusades, namely, the foundation of the Knights of St. John or Hospitallers, and the growth of the Order and its work is fully described. Briefly covered are the early years of spread of the plague of syphilis, and the part played by the mercenary armies of Charles VIII of France.

The gunpowder era brought new types of wounds and new techniques to deal with them. The pioneers mentioned include Hans von Gersdorf, Paracelsus, Paré, and Giovanni di Vigo, who was also noted as an early user of mercury in the treatment of syphilis.

Throughout history the same diseases keep recurring: smallpox, plague, typhus, and, since 1492, syphilis. In more recent times, plague forced Napoleon to give up his siege at St. John of Acre and may have altered the shape of history.

The work of Larrey, Napoleon's surgeon, is fully covered, for he can be considered as the forerunner of the modern army surgeon. Larrey was responsible for some excellent observations on trachoma which affected the French armies in Egypt, and for the introduction of ambulances for speedy evacuation of wounded. He had to deal also with scurvy, for the protective effect of lemons, described in 1753 and generally adopted in the British Navy some forty years later, was not yet known to him.

So far there has been little description of any humanizing elements in war and disease, but the Crimean War produced Florence Nightingale, who revolutionized nursing. She reduced the mortality in the hospitals in Scutari from 427 per thousand to 22 per thousand in a few months. In her time the mortality among soldiers in peace-time was twice that of the civilian population, and she was responsible for many reforms in the Army Medical Services. In her footsteps came J. Henry Dunant, an eyewitness of the Battle of Solferino, whose experiences there led him to the formation of the Red Cross Society in 1863.

The Spanish-American War receives full attention both in its political and in its medical aspects, with due importance given to yellow fever and its investigation by Reed and others. The investigation and control of typhoid fever is traced from the Spanish-American War through the Boer War to the present time. Japanese methods and thoroughness are shown in the re-organization of their army medical services after the Chinese War of 1894 when disease caused four times as many deaths as did wounds, so that the proportions were reversed in the Russian War only a few years later.

In the War of 1914–18 the main points studied were the reduction in the rate and mortality in typhoid, influenza, venereal disease, gas gangrene, and tetanus, and the improvements in artificial limbs and plastic surgery. Shellshock brought the psychiatrist to the fore. One of every five men invalided out of the Army passed through the hands of the psychiatrist. The proportion is as great to-day. Perhaps the wars of the future may be fought bloodlessly by an exchange of psychiatrists. The Italo-Abyssinian War was conspicuous by the absence of scurvy and louse-borne diseases from the large Italian Armies, although both were rife on the Abyssinian side.. The Spanish Civil War was the testing ground for the Winnett-Orr technique in wound surgery. Sulphonamide therapy is the only subject covered in the present War.

This book is an excellent short survey of the subject and does not suffer by the author's occasional digressions into local politics. That its reading is none too easy is the fault of war-time conditions of small type and restricted space, and this, too, has no doubt reduced the number of possible illustrations which could have enhanced the interest.

J. MARSHALL.

RECENT ADVANCES IN THE THEORY OF THE FUNDAMENTAL PARTICLES OF PHYSICS

By Prof. R. H. FOWLER, O.B.E., F.R.S.

AT the meeting during January 2–4 in Calcutta of the Indian Science Congress, Dr. H. J. Bhabha was president of the Section of Physics. His presidential address on the theory of the "Fundamental Particles of Physics", to which he has himself made important contributions, has recently been received in Great Britain.

Dr. Bhabha starts by reviewing the manner in which the basic concepts of physics have been generalized from those of the nineteenth century, first by the incorporation of the unified space-time of the theory of relativity and then of the requirements of the quantum theory. This process of incorporation is still incomplete, but significant progress has been made, about which Bhabha's address contains, as one would expect, much interesting comment.

Bhabha starts by reminding us of the fact—which we all know but sometimes forget—that, when the recognition of new facts of observation requires the use of wider postulates than heretofore as the basic postulates of physics, the generalized theory is inevitably more, not less, exacting in its demands on the fundamental equations of physics. The generalization results in *less*, not more, freedom of choice of quantities that the theory determines *a priori*. For example, the special theory of relativity requires the fundamental equations of physics to be invariant for the transformations of the Lorentz group, whereas in Newtonian physics the laws need only be invariant for all transformations of the three-dimensional space-rotation group, which is a sub-group of the Lorentz group. It is important to realize that it is just this generalization which eliminates much arbitrariness from Newtonian physics. In Newtonian theory, the interaction between two particles can be chosen entirely arbitrarily and only determined empirically by observation. In the relativistic generalization, the interaction can no longer be given by an arbitrary static function, for such a specification would not be invariant for the extended Lorentz group of transformations. In relativistic theory the interaction between two particles at a distance must be carried by the medium of a field, and the field functions, u, of this field *must* satisfy the generalized wave equation

$$\frac{\partial^2 u}{c\partial t^2} - \frac{\partial^2 u}{\partial x^2} - \frac{\partial^2 u}{\partial y^2} - \frac{\partial^2 u}{\partial z^2} + \chi^2 u = 0,$$

in which χ is an invariant which may be zero. The assertion "must satisfy" above is strictly an overstatement of the logical position. The u-equation given is the *simplest* possible invariant differential equation which u can satisfy and perform its required functions. There are, however, more complicated equations of higher order which u might satisfy alternatively, but these can still rightly be ruled out on grounds of less simplicity, until by exhaustive study it has been found that the observed facts demand the greater complication. For the present we are not so faced, and may provisionally conclude that relativistic invariance restricts us (in the static case) to a variation of the potential energy of interaction of two particles, a distance r apart, of the form

$$\frac{e^{-\chi r}}{r},$$

or a combination of this function and its space derivatives.

The requirements of the generalization of classical mechanics to cover the quantum theory add to these relativistic restrictions an entirely distinct set of additional restrictions; the combined effect of relativity plus quantum theory is so stringent that one can formulate precisely all the theories that are possible in conformity with both generalizations, and Bhabha describes in his address the various arguments and stages in this notable development, pointing out where the formulation is still inadequate. An important point established even by an incomplete formulation of relativistic quantum theory is that a one-particle theory is impossible. Even if one starts with one particle, there is always the possibility that the number can be increased by pair creation. Recognizing this, one sets out with the objective of a many-particle theory, in which the number of particles is not conserved. Such a theory requires the use of *two* tensors at least: (i) an energy-momentum tensor ∂, one component of which gives the energy density of the particles at any point of space-time; and (ii) a charge-current tensor, one component of which gives the charge density at any point of space-time. Such a theory can be formulated, but for particles of half odd-integral spin the total energy is not necessarily positive. This is the generalized form of the difficulty first met with by Dirac in his relativistic theory of the electron. It can be satisfactorily turned in the same way as in Dirac's theory, if the particles obey the Fermi-Dirac statistics, and a vacuum corresponds to conditions in which the negative energy states are all full. One concludes that *a physically sensible theory of particles of half odd-integral spin* ($\frac{1}{2}\hbar$, $\frac{3}{2}\hbar$, $\frac{5}{2}\hbar$, ...) *is only possible if the particles obey the Fermi-Dirac statistics.* Somewhat similar arguments first completed by Pauli and Fierz enable one to conclude that *a physically sensible theory of particles of integral spin* ($\hbar$, $2\hbar$, $3\hbar$, . . .) *is only possible if the particles obey the Einstein-Bose statistics.*

These conclusions as to the relation between spin and statistics of possible fundamental particles are stressed by Bhabha as a remarkable example of how widening the basic concepts of a theory, as here by the unification of relativity and quantum theory, leads to a drastic reduction in the outstanding arbitrariness in the theory and to a consequent advance in our understanding of the basic properties of the fundamental particles of physics.

The address next describes recent progress that has been made in eliminating infinities and divergent results from the relativistic (non-quantum) theory of the point electron. It has been realized recently (the first indication was the discovery of the neutron) that the finite inertial mass of a moving charge need not, and in fact can not, be tied on its non-zero size as in Lorentz's theory of the electron. It is best at the present stage to regard mass as a constant of a fundamental particle not determined by the relativistic quantum theory formulation, of the depth discussed in this address, and to abandon any attempt to assign a structure to a fundamental particle. The problem then arises of developing a satisfactory infinity-free theory of a structureless point-particle, reacting with a radiation field. Much progress has

already been made with the problem. Dirac and Pryce have shown that such a relativistic classical theory of a point electron is possible, taking into account exactly its interaction with the field of electro-magnetic radiation. This success has been extended by Bhabha himself to particles with charge, spin and dipoles, and to such particles moving also in 'meson' fields—that is, fields of the type that arise when the particles interact with each other by continual creation and reabsorption of mesons or heavy electrons of either sign, as appears to be the habit of protons and neutrons. The development of this exact classical theory appears to be a step of great importance, although it has not yet been successfully incorporated in the quantum theory. It is, of course, possible that the extended formulation necessary for this step is so profound that it will turn out to require the fixing of the at present arbitrary inertial masses and dipole strengths attributed to the fundamental particles, which survive in the present exact classical theory—perhaps somewhat after the manner of Eddington's generalized theory. This is a problem for the future: discussion of Eddington's generalizations lies outside the range covered by Bhabha's address.

The programme for the formulation of a relativistic quantum theory contemplated in Bhabha's address is, as we have seen, as yet incompleted and perhaps incompletable. None the less, it is of great interest to pause a moment and consider what sort of world of fundamental particles it could provide us with, and how they would satisfy the requirements of observation. We shall give full weight to all considerations of maximum allowable simplicity, such as assuming that the fundamental particles only have charges $\pm e$ or zero, and no electric dipole moment in a co-ordinate system in which they are at rest, and that particles of unobserved type do not exist unless, of course, their existence follows theoretically from the existence of particles of a type required by observation. On this basis the completed programme would provide us with a set of light 'point' particles—electrons, positrons and neutrinos with charges $-e$, $+e$ and 0 respectively, all with spin $\frac{1}{2}\hbar$ and obeying the Fermi-Dirac statistics. The electron and positrons have identical masses and magnetic dipole moments, but the actual values are not fixed by the programme, nor are the mass and dipole moment of the neutrino, which may differ from those of the electron. The mass of the neutrino is required by observation to be very small compared with that of the electron, and may well be zero. The light particles interact with each other through their electromagnetic fields.

The programme provides us also with a set of heavy 'point' particles—protons (negative protons) and neutrinos of charges e, $-e$ and 0, spin $\frac{1}{2}\hbar$ and obeying the Fermi-Dirac statistics. The protons and negative protons have identical masses and magnetic dipole moments, but the actual values are not fixed by the programme, nor are the mass and dipole moment of the neutron, which may (and in fact do) differ from those of the proton. One would not expect to have observed negative protons. The heavy particles interact with each other through both electromagnetic and meson fields.

The programme also provides us with a set or sets of intermediate particles or mesons, the creation and annihilation of which provide the essential meson field mentioned above. Mesons of charge $\pm e$ and a mass about 170 times that of the electron will provide a meson field of essentially the correct characteristics. Such particles can be unstable and capable of spontaneous conversion into a light electron and neutrino. Such instability is required to account for natural β-ray radioactive decay and for the properties of free mesons as observed in the cosmic rays. Further details are as yet scarcely clear.

The fundamental particles of the programme are thus a rather numerous family of a structure not so simple as the purist might desire before attaching to his satisfaction the label *fundamental*. None the less, such a synthesis or enumeration when completed would represent a magnificent advance, not only for the parts of the theory that it tidies up, but also for the untidy ends lying about which it emphasizes—the undetermined inertial masses and magnetic dipole moments with their rather surprisingly queer ratios. It is here that this programme, which one might describe as the classical relativistic-quantal programme, appears to have reached the bounds of its foreseeable development. One may reasonably expect that further progress will require profound reformulation—proceeding possibly, as suggested above, along paths already indicated by Eddington.

NATIONAL FLOUR AND BREAD

THIRD REPORT

From the Scientific Adviser's Division, Ministry of Food

THE first and second reports[1,2] covered the analyses of 622 samples of flour and 459 samples of commercial bread received up to early October 1942. The present report deals with a further 379 samples of flour and 381 samples of bread received in the period ending May 8, 1943.

Quality of Flour

In the period under review, certain changes have been made in the composition of National flour. There has been an increase in the percentage of home-grown wheat used, which at present averages 43·6 per cent. Since mid-March the addition of 2 lb. of skim milk powder per sack has been general (90–95 per cent of the flour is now so fortified) while from February 13, barley or a mixture of groats (dehulled oats) and barley has formed part of the grist.

In May 1942, a start was made on the addition of calcium carbonate (in the form of creta præparata) to flour at the rate of 7 oz. per sack, and at the end of April 1943, approximately 89 per cent of the National flour produced in the United Kingdom was so fortified.

Fibre and B_1. The following table shows the different levels of fibre and B_1 over the 379 samples of flour.

Fibre		B_1	
Value per cent	Per cent of Samples	I.U./gm.	Per cent of Samples
⩽ 0·4	9·8	⩾ 1·20	4·5
0·5	33·8	1·10	23·0
0·55	49·6	1·05	40·1
0·6	61·5	1·00	67·8
0·7	84·5	0·90	92·4
0·8	93·1	0·80	98·0
0·9	97·8		

A correction has been made in the fibre figures to allow for the addition of any Canadian G.R. flour.

The 'national average' figures for fibre and B_1 are

now approximately 0·55 per cent and 1·00–1·05 I.U./gm. respectively. The corresponding figures for the period March–October 1942 were 0·7 per cent and 1·05–1·10 I.U./gm.[2]; there has thus been an appreciable reduction in the fibre content and a slight fall in the B_1 content.

The reduction in fibre is due to new methods of milling (foreshadowed in the second report) and represents a definite improvement in the quality and digestibility of the flour[3].

The very slight fall in B_1 is due to the higher percentage of home-grown wheat used and the lower bran content of the flour (as shown by the fibre figures).

The extractions from any added barley and groats have been fixed for the present at 70 and 85 per cent respectively. Laboratory milling tests have shown that at these extractions, the dilution will have no significant effect on the fibre and B_1 of the finished National flour. This has been confirmed by close analysis of the fibre figures of commercial flours received since February 13.

Protein and Riboflavin. The protein content largely depends, of course, on the composition of the grist. The following figures show this :

Grist	Protein content (N × 5·7) of National flour
	Per cent
50 per cent Manitoba No. 1 ; 30 per cent Manitoba No. 2 ; 10 per cent Plate ; 10 per cent English ..	13·2
70 per cent Manitoba No. 1 ; 30 per cent English	12·3
All English (2 parts red and 1 part white) ..	8·3

Twenty-two samples of flour taken at random from those received in the period February 12, 1943, to April 4, 1943, and covering large and small mills over the country were examined for protein with the following results :

	Range	Average
Protein	10·7–12·0 per cent	11·3 per cent
Riboflavin	1·4–1·9 μgm./gm.	1·5 μgm./gm.
Fibre	0·25–0·75 per cent	0·50 per cent
B_1	0·8–1·10 I.U./gm.	1·00 I.U./gm.

The average figure of 11·3 per cent is consistent with about 50 per cent English wheat in the grist. The opportunity was also taken to obtain an average figure for the riboflavin content of National flour. Figures are also given for the fibre and B_1 for these 22 samples of flour.

Granularity. Not only the amount but also the size of the bran particles continues to diminish and the following table gives a summary of all the samples examined to date. In every case, correction has been made for any added Canadian G.R. flour :

Sample Nos.	Dates of Examination	Total per cent over 5 silk	Total per cent over 8 silk
1–100/42	1.1.42–19.3.42	11·9	15·0
101–200/42	–16.5.42	10·5	14·9
201–300/42	– 5.7.42	9·3	14·2
301–400/42	–28.8.42	8·4	13·0
401–500/42	–16.10.42	5·5	9·9
501–600/42	–17.12.42	3·8	7·7
601–636/42	–31.12.42	3·5	7·7
1–100/43	–16.2.43	2·4	6·5
101–200/43	– 9.4.43	2·2	6·2
201–250/43	– 6.5.43	1·9	5·8

Aperture No. 5 silk = 0.270 mm. ; Aperture No. 8 silk = 0·190 mm.

Conversion Factor, Flour-Bread. Working at the optimum absorption, one sack of 280 lb. of National flour will yield approximately 380 lb. of bread (190 loaves of 2 lb. each), that is, 1 lb. of flour gives 1·36 lb. of bread. Many bakers use up to 1 gallon of water per sack less than the optimum, so that the average figure is probably near enough to 1·34.

Quality of Bread

A report was published recently[4] on the effects on bread quality of the addition of barley and groats to National flour. Both cereals tend to pull down the quality of the bread if present in large amounts. Two standards of bread quality were considered :

1st standard = best quality commercial bread being made in December 1942.
2nd ,, = satisfactory commercial bread.

Using these two standards, the following are roughly the limits of dilution for each diluent, added separately :

	1st standard	2nd standard
Barley		
Hand-baking	6–8 per cent	15 per cent
Machine-baking	5	10
Groats		
Hand-baking	3	6
Machine-baking	2	5

10 per cent barley, for example, gives a loaf smaller in volume with a somewhat harsher crumb of duller colour.

Increasing the percentage of home-grown wheat used will also lower the loaf quality as judged by the baker. The addition of creta præparata and skim milk powder has had no effect on the baking quality of National flour.

The following is a summary of the quality of the 381 commercial samples of bread received from different parts of the country since the second report was written. In brackets are the corresponding percentages for the previous 459 samples of bread examined :

Quality	No. of loaves	Percentage
Good	112	29 (61)
Fair—good	99	26 (22)
Fair	117	31 (13)
Poor	53	14 (5)

It is evident that there has been a fall in the loaf quality of the bread being sold, although nutritionally it has improved. The fall, however, is not greater than what might be expected because the period during which samples were taken covered that when bakers were not accustomed to the new type of flour, which included a high percentage of home-grown wheat and a proportion of barley and/or groats. Both these factors would lower the tolerance of the flour to variations in baking conditions.

The experimental work in this report was carried out in the Laboratories of the Research Association of British Flour Millers, St. Albans.

[1] and [2] NATURE, 140, 460 (1942) ; 150, 538 (1942).
[3] Moran, T., and Pace, J., NATURE, 150, 224 (1942).
[4] Technical Baking Panel, Ministry of Food ; Milling and Baking Press, (April 2, 1943).

VISUAL PURPLE

By PROF. RAGNAR GRANIT

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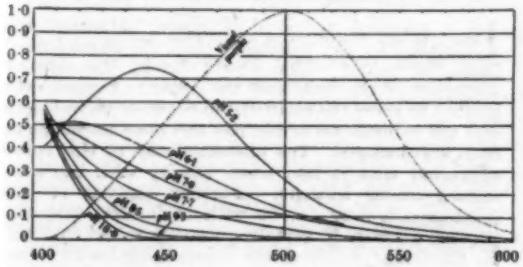
WHEN the late Dr. R. J. Lythgoe, of University College, London, about 1935, took up research on visual purple—the photosensitive substance of the retinal rods—our knowledge in this field had advanced but little since the beginning of this century. To a large extent his own precise and well-planned work, partly carried out in fruitful collaboration with Dr. C. F. Goodeve as an expert on photochemistry, is responsible for the clarity that now makes it possible to write about this subject with feelings of satisfaction. As very few British physiologists have taken an active experimental interest in the subject of vision, the work of Lythgoe has not received the recognition that it deserves, and so, perhaps, it is fitting that an appreciation should come from a colleague abroad. Though all Lythgoe's contributions to the problems of sight were stamped with the same hall-mark of quality, no better tribute can be paid to his memory than to indicate in a brief review the place and significance of his work on visual purple against the background of past and present contributions to the same subject—one particularly dear to him. I can only quote a selected number of papers in the list of references. From these papers and an earlier review (Granit, *Documenta Ophthalm.*, **1**, 7; 1938) those interested in the subject will easily find the rest of the references. Lythgoe's own summary (*Brit. J. Ophthalm.*, **24**, 21; 1940) is of particular interest as a final statement of his matured views on the subjects of visual purple and dark adaptation.

The old work of König (1894) and his pupils and that of Trendelenburg (1904) had already suggested rather definitely that the human scotopic luminosity curve, which pictures the spectral distribution of sensitivity of the dark-adapted (scotopic) eye, was determined by the spectral absorption curve of visual purple. But the precise form of this absorption curve was still the subject of discussion. Kühne had shown about 1880 that visual purple was bleached by light to a yellow photoproduct (visual yellow) and, if he was right, as others afterwards denied, the yellow substance could be expected to interfere with the measurements of visual purple absorption at the shorter wave-lengths. However, the most recent evidence (Nakashima, 1929, Hosoya, 1935, Chase, 1936) supported Kühne's view and indicated that the cause of older differences of opinion lay in the varying degrees of acidity of the solutions.

Clearly it was necessary to study the spectral absorption curves for visual purple extracts of a very high degree of purity and to follow up this work by analysing the absorptive properties of the various photoproducts found in the course of the bleaching of solutions containing this extremely light-sensitive substance. With characteristic thoroughness and technical perfection Lythgoe embarked upon this programme of research. In the accompanying figure is shown Lythgoe's (1937) absorption curve for visual purple with its maximum at 0·502 μ. Illumination destroys this substance, leading to formation of a photoproduct (left in illustration) that shifts its spectral locus with the degree of acidity of the solution, being yellow in moderately acid solutions and colourless in alkaline solutions, because its maximum is then in the invisible ultra-violet. For this reason Lythgoe called this photoproduct "indicator yellow". This substance is very insensitive to light, and can scarcely play a part in perception except as a filter. This work was soon confirmed by others (Saito, 1938, Chase, 1938, Wald, 1938) but has never been surpassed in accuracy. Krause and Sidwell (1938) have followed the changes farther out into the ultra-violet region.



Engaged in studying the breakdown of visual purple under the influence of light, Lythgoe (1937) made the important discovery that the first step in this process was the formation of an orange intermediate photoproduct which was immediately transformed to indicator yellow, unless the solution before illumination had been cooled in ice. On account of its colour and instability to heat he called this substance "transient orange". The difficult task of measuring the absorption curve for transient orange was successfully tackled by Lythgoe and Quilliam (1938), who found it to possess a maximum around 0·470 μ. This substance may play a part in vision. Thus, as the first result of Lythgoe's work, the old inheritance of concepts with no definite physical meaning such as 'visual yellow' and 'visual white' were replaced by concepts corresponding to substances characterized by their absorption curves and certain other properties such as stability to heat, light, acidity, etc. Kühne's 'visual yellow' embraced both indicator yellow and transient orange. If substances other than these two are formed in the course of bleaching or spontaneous breakdown of visual purple or its yellow photoproduct, as claimed by Wald (1938), they have not yet been demonstrated in a convincing manner. Lythgoe himself was unable to find them.

The discovery by the Danish workers, Fridericia and Holm (1925), confirmed by Tansley (1931) with a more accurate method, that vitamin A deficiency leads to delayed regeneration of visual purple and to nightblindness, inspired several workers to study the vitamin A content of the retina. It was found (Haurowitz, 1933, v. Euler and collaborators, 1933–35, Krause, 1937–38, Wald, 1935–37) that vitamin A and carotene occurred in the pigment layer, but that visual purple was identical with neither substance. However, Wald made the significant discovery that the yellow photoproduct obtained by illumination, or disruption of the visual purple molecule by other means, could easily be extracted by organic solvents and then had the chemical property of a carotenoid. Wald called it 'retinene'. His claim that the final colourless product of bleaching *in vivo* is vitamin A has been opposed by Krause and Sidwell (1938). At any rate, vitamin A is not formed during the bleaching of visual purple in solution. The closely related visual violet, found in certain fishes (Köttgen and Abelsdorff, 1896, Bayliss, Lythgoe and Tansley, 1936) and possessing an absorption spectrum shifted

some 0·030 μ towards the red, breaks down in a similar manner, forming a russet-coloured product, another carotenoid, retinene$_2$ (Wald, 1939). It is an interesting fact that retinæ possessing visual violet contain vitamin A_2 instead of the ordinary vitamin A_1. No doubt, therefore, the A-vitamins are of importance for the formation of the chromophoric group of the visual purple molecule even though it may not be possible at present to describe the nature of this relationship. Lönnberg (1935–37) has isolated large amounts of another carotenoid, xanthophyll, from the retina, and Lythgoe (1940) undoubtedly was right in pointing out that some essential link in our knowledge is missing as long as this finding has not been accounted for.

All old and recent work (Hecht, Krause, Lythgoe, Wald) shows visual purple to be a protein. It has a high molecular weight and is precipitated by water-soluble organic solvents. It shows cataphoretic properties with an iso-electric point (Broda, Goodeve, Lythgoe and Victor, 1939), has the ultra-violet absorption spectrum of proteins (Krause, Goodeve, Lythgoe), and the kinetics of its thermal decomposition, studied by Lythgoe and Quilliam (1939), is consistent with the same view. We may regard visual purple as a 'chromoprotein' in which the chromophoric group is Wald's carotenoid retinene. The molecular weight of that part of the chromoprotein which contains one chromophore is called its 'carrier weight'. Broda, Goodeve and Lythgoe (1940) found the carrier weight to be somewhat below 26·500, a value not far from Svedberg's fundamental protein unit (about 17·600). Putting the molecular weight, determined by Hecht and Pickels (1938), equal to 270·000 and dividing by the carrier weight 26·500, gives the number of chromophores attached to each molecule, which accordingly is about 10. The chromoprotein occupies some 5–10 per cent of the volume of the outer limb of the rod. From different points of view both Lythgoe (Bayliss, Lythgoe and Tansley, 1936) and I arrived at the conclusion that the photosensitive substance is localized on the surface of the rods.

According to Lythgoe (1940), then, light acts on the chromoprotein by loosening the bond between protein and chromophore and so renders the latter more soluble in organic solvents. Thus retinene becomes extractable. Indicator yellow is probably still a conjugated protein, apparently identical with Wald's retinene-protein. Goodeve and Lythgoe think it probable that the essential chemical change caused by the excited visual purple molecule is one of hydrolysis.

Goodeve and Lythgoe in collaboration with Dartnall and Schneider have published several important contributions to the photochemical aspects of the problem. They have determined the quantum efficiency of visual purple (equal to or not far below unity), followed the time course of bleaching, proved that Lythgoe's absorption curve exactly reproduces photosensitivity, determined the molecular extinction coefficient ($2{\cdot}3 \times 10^4$ for wave-length 0·560 μ), and studied the photosensitivity in the ultra-violet. In an aphakic eye (eye without lens) the sensitivity to light was found to reach far out into the ultra-violet (0·300 μ), following there, too, the curve for the photosensitivity of visual purple.

As is well known, visual purple regenerates in the dark, even in solution (Kühne, 1878), though under such conditions to a relatively limited degree (Hecht, Lythgoe). It has been shown by Zewi (1939, 1940) that there are two kinds of regenerative processes in the living retina, one of which is dependent upon the oxygen supply. The other takes place also in a nitrogen atmosphere. A most interesting point is that the rate of regeneration is favoured by previous illumination of the retina (Bauer, 1911, Zewi, 1939) or even *in vitro* by illumination of solutions (Chase, 1937). But if the animals are illuminated with strong light for a *brief* period there may first be a period of absolute standstill of the regenerative processes (Zewi). Now, to quote Lythgoe (1940): "It seems possible that we have two methods for the regeneration of visual purple. Regeneration from its breakdown products almost certainly involves the addition of energy to the system, and this energy can be provided either by the absorption of light or by a chemical process needing oxygen". The vitamins and other carotenoids are probably involved in relatively complex catalysed reactions which so far are unknown. The regeneration from the orange or yellow photoproducts probably consists in a strengthening of the bond between the protein and its chromophore. Lythgoe found regeneration from transient orange to be particularly fast, and made the remarkable statement that the chromoprotein, regenerated from this stage, had an absorption band and other properties which did not quite agree with those of the parent visual purple. He suggested that cone substances may be formed in this manner. Elsewhere (1941, 1943) I have pointed out that the electrophysiological evidence also supports the view that cone substances are closely related to visual purple.

At this stage Lythgoe's work was interrupted by his untimely death, at a moment when he planned collaboration with a biochemist to elucidate the chemical structure of the photosensitive substances in the retina. A particularly fascinating line of research thus awaited Lythgoe just when he had to lay down his tools. How admirably they were used I hope to have indicated by this attempt to interpret a consistent and harmonious development of experiments and ideas, hand in hand.

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PHYSIOLOGY OF COLOUR VISION

By E. N. WILLMER

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IN a previous article in NATURE[1], attention was directed to the possibility that the physiological basis for colour vision might lie in the relative responses of the rods and the cones. A curve was plotted to show the relationship between wave-length and the summation of the rod and cone responses at each wave-length. The characteristics of this curve suggested that it had some affinity with the well-known colour triangle. Further analysis of this phenomenon may not be without interest and also provide answers to certain questions raised by Prof. H. Hartridge in his recent communication[2].

In attempting to decide which was the significant relationship between the rods and the cones—their summation, difference, ratio or what not—the percentage of maximal rod response was plotted against the percentage of maximal cone response, that is, rod sensitivity against cone sensitivity, for each wave-length. The figures were plotted directly from the scotopic and foveal photopic visibility curves given by Abney[3] for the arc-light spectrum, and the result obtained is shown in Fig. 1. This curve has more features in common with the colour triangle than the one to which attention has already been directed.

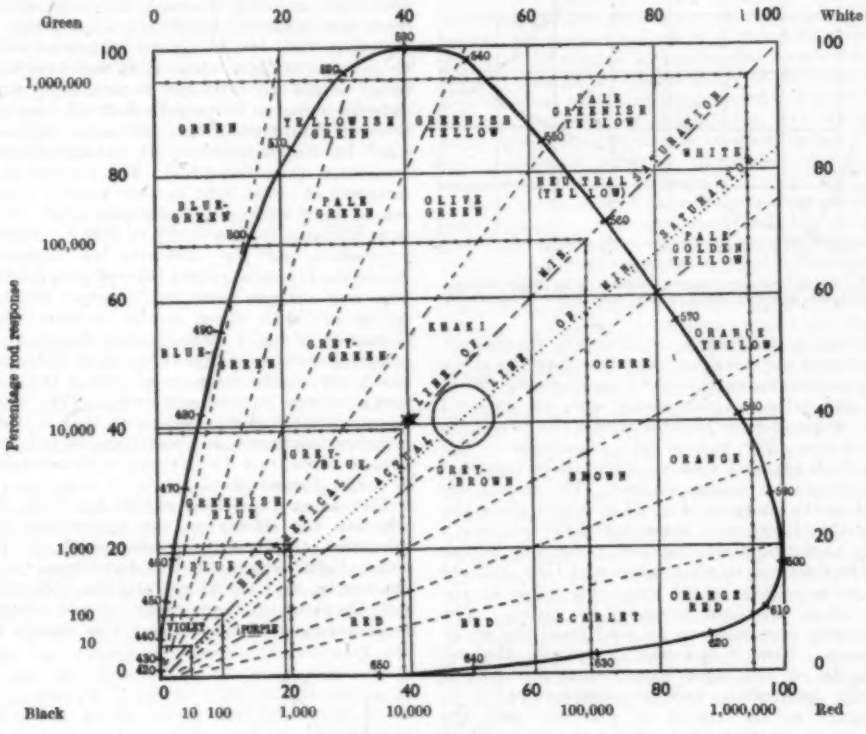

FIG. 1. LOCUS OF THE SPECTRUM IN TERMS OF ROD AND CONE RESPONSE.

Full line, locus of spectral colours; broken lines, direction of movement of locus with change of intensity; lines with dots, levels of light intensity (units in terms of number of times threshold level). Circle indicates region in which lines joining complementary wave-lengths intersect. Star indicates point of intersection of complementaries corrected for intensity.

The C.I.E. colour chart is shown in Fig. 2 for comparison, and it is clear that the curves are strikingly similar except for wave-lengths longer than 600 mμ and shorter than 470 mμ.

The interpretation and significance of this new diagram may now be briefly considered. In the first place the zero point, representing no activity of rods or cones, may be regarded as indicating blackness; conversely the point representing 100 per cent rod and 100 per cent cone activity may be interpreted as white. The line joining the two represents colourless sensation, grey to white. It is the line of minimal saturation and cuts the spectral curve at 560 mμ. The position of minimal saturation in the spectrum is in fact generally found to be between 560 mμ and 570 mμ. The possible significance of this slight difference will appear later. If lines are drawn to connect those pairs of wave-lengths which are complementary, they all, except when wave-lengths greater than 610 mμ are involved, intersect in the region of the circle in the diagram. This would mean that if quantities of the spectral colours were mixed in a 50 : 50 ratio the colour obtained would have its locus in the neighbourhood of the circle. This circle does not quite lie on the line of minimal saturation, but a line joining its centre with the zero point intersects the spectral curve somewhat nearer 570 mμ, that is, somewhat nearer the actual point of minimal saturation in an arc spectrum.

Now it is found that only very few spectral colours are exactly complementary when mixed in equal proportions; nearly always the intensity of one has to be increased. For this and other reasons it is therefore relevant to consider the effects of changes of light intensity in connexion with the diagram. There are no figures available to show the relationship between impulse frequency and light intensity in human optic nerve fibres, but Hartline[4,5] has studied this question in single nerve fibres from the eye of Limulus and also from the eye of the frog. There is a striking similarity between the two, especially when the frog nerve fibre investigated belonged to

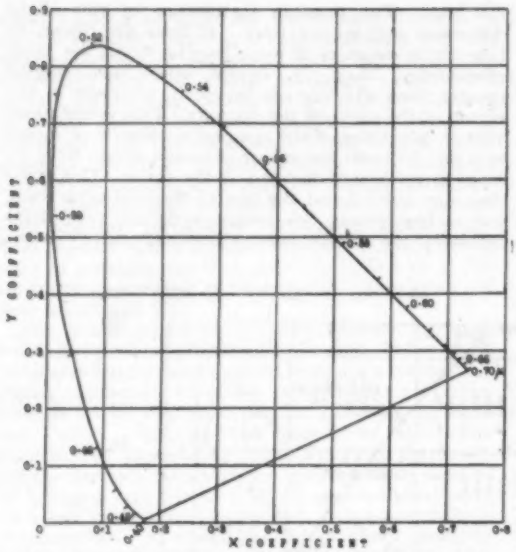

Fig. 2. C.I.E. COLOUR CHART PLOTTED WITH RECTANGULAR CO-ORDINATES, SHOWING LOCUS OF THE COLOURS IN THE SPECTRUM.

the type which discharged continuously throughout the duration of the stimulus. As a first approximation it may therefore be legitimate to use these figures to indicate the extent of the energy changes required to alter the impulse frequencies arising from the rods and the cones. For lack of any knowledge to the contrary both types of sensory cell must be regarded as responding in a similar manner. The results are indicated in the diagram (Fig. 1) in scales along the axes (10, 100, 1,000, etc., times threshold intensity). The lines radiating from the zero point join points having identical rod to cone ratios and thus indicate the change in position of the locus of a colour on the diagram when the light intensity is varied. The energy change involved can be read from the scales on the axes. Now it is found in practice that all wave-lengths of red light longer than 609 mμ, if sufficiently intensified, become complementary to wave-lengths in the region of 490 mμ, and the diagram makes it clear that raising the intensity of colours of long wave-lengths moves their loci all in the direction of 609 mμ. Similarly, all wave-lengths shorter than 430 mμ are complementary to 561 mμ. Now, when lines joining 490 mμ with 609 mμ, and 430 mμ with 561 mμ, are drawn, they intersect on the line of minimal saturation at the point 40, 40. In this connexion, then, all reds beyond 609 mμ may be considered as identical except in intensity, and the same is true for all violets of wave-length shorter than 430 mμ. This would seem to provide an explanation for the telescoping of the spectral extremes in the traditional colour diagram (Fig. 2), and it is probable that the position of the point of minimal saturation in the spectrum is apparently shifted towards the red end of the spectrum because of the energy distribution in the spectrum.

Prof. Hartridge raises the point of why it is not possible to make any other colours than purples, mauves and crimsons by mixing extreme reds and extreme blues in different proportions, since by hypothesis these latter colours respectively stimulate cones only and rods only, and therefore ought to be capable of producing any combination of rod and cone response, that is, any colour. The answer to his difficulty is apparent from the diagram (Fig. 1), since the colour obtained on mixing red and violet pigments will lie along the line joining the loci of the two colours in question and, therefore, in the bottom left-hand corner of the diagram. On mixing lights, greens and browns should theoretically be possible, but never yellows, since the frequencies characteristic of these colours could not be produced from mixtures of violets and reds, for if the intensity of the violets and reds were sufficiently raised they would then be classed as blue-greens or orange-reds. Moreover, in order to raise the impulse frequency from the values characteristic of extreme reds and violets to those characteristic of greens and browns, an increase of light intensity of well over a thousand times would be necessary; and since violets and extreme reds, to be perceived at all, require a high level of illumination, this enormous further increase may be impracticable. It is significant in this connexion that Burch[6] in 1898 noticed that if the intensity of violet light be very greatly increased the sensation of emerald green is produced. This change is predictable from a study of Fig. 1. Similarly and conversely, as the intensity of illumination is diminished, yellow-greens become progressively more blue and oranges more red, changes which are also coincident with those to be expected from consideration of Fig. 1. The eye as a whole is constantly adapting itself to different levels of illumination and has a very wide range even within the limits over which colours can be perceived. The 'white' point made by mixing red and green will in the absence of other brighter light, and because it is colourless, appear white, but if compared with a brighter white it would appear grey.

The second question raised by Prof. Hartridge concerns the effects on the appearance of colours examined after previous adaptation of the eye to violet light which (if the hypothesis be correct) stimulates, and therefore fatigues, rods only, or to red light which conversely should decrease the responsiveness of the cones. The answer to this is

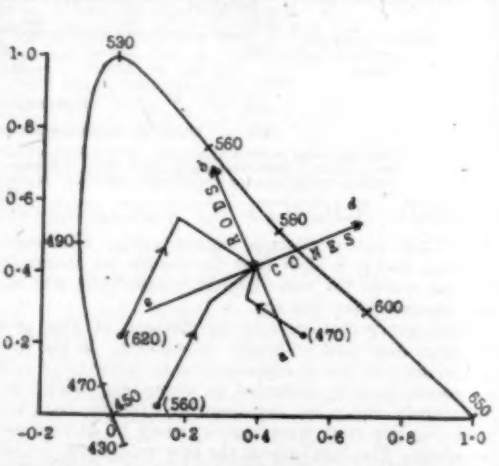

Fig. 3. Colour chart showing the shift of the 'white point' following adaptation to red (620), yellow (560) and blue (470), and the paths followed on its return to the normal position. [Data from Wright (1934).] Probable directions of axes representing rod and cone responses indicated by lines through the 'white point': *ab*, rod axis; *cd*, cone axis.

perhaps best provided by a study of the results obtained by Wright[7] when he investigated this question in 1934. Fig. 3 has been constructed from his data and shows (*a*) the shift in position of the 'white' point in his colour diagram as the result of previously exposing the eye to red, yellow or blue, and (*b*) the paths followed by the locus of the point during its return to the normal position. If this colour diagram be related to Fig. 1 it is probable that the positions of the axes representing rod and cone activity lie roughly parallel to the directions of the lines drawn through the 'white' point. Any movement of the point to the left of the line *ab* indicates depression of cone activity, and any movement of the point to positions below the line *cd*, depression of rod activity. The red (620 mμ) used stimulates rods and cones in the proportion of 7 : 90 and the displacement of the 'white' point is in the proportion of 4 units along the rod axis and 42 units along the cone axis. The corresponding figures for the blue (470) and the yellow (560) are shown in the following table :

	Stimulation		Displacement	
	Rods	Cones	Rods	Cones
Red	7	90	4	42
Blue	30	5	22	5
Yellow	72	72	25	40

The figures speak for themselves, so far as the initial displacement is concerned ; the significance of the recovery paths is not so clear, but may be related to the different rates of recovery of the rods and cones and to general re-adaptation to the experimental conditions required for making the necessary matches.

The figures used throughout this article have, as already stated, been derived from the scotopic and foveal photopic visibility curves for the arc-light spectrum. The diagram will be considerably modified for spectra with different energy distribution, and the exact shape and position of the visibility curves is consequently of importance in any more detailed analysis. That the foveal visibility curve is so similar to the ordinary photopic curve and apparently can be regarded as the cone curve is of interest in that it suggests that at all levels of illumination at which cones are functional it is chiefly to their activity that we owe the sensation of brightness.

Finally, it is of interest to note that the line of minimal saturation divides the spectral curve into two portions, and the distance from this diagonal represents the positive or negative difference between the rod and cone responses for each wave-length. Distances along the diagonal represent the summation of the rod and cone responses. Since the differences vary with the wave-length, it is not surprising that the summation of rod and cone responses when plotted against wave-length should have some of the properties of the colour triangle, as was noted in the previous article[1].

[1] Willmer, E. N., NATURE, 151, 213 (1943).
[2] Hartridge, H., NATURE, 151, 422 (1943).
[3] Abney, W. de W., "Colour Vision" (London, 1895).
[4] Hartline, H. K., and Graham, C. H., *J. Cell. Comp. Physiol.*, 1, 277 (1932).
[5] Hartline, H. K., *Amer. J. Physiol.*, 121, 400 (1938).
[6] Burch, G. J., *Phil. Trans. Roy. Soc.*, B, 191, 1 (1898).
[7] Wright, W. D., *Proc. Roy. Soc.*, B, 115, 49 (1934).

OBITUARIES

Sir Arthur Newsholme, K.C.B.

SIR ARTHUR NEWSHOLME was born at Haworth, the village of the Brontës, on February 10, 1857. He received his medical education at St. Thomas's Hospital and took the degree of M.D.(Lond.) after a brilliant academic career. After holding resident appointments at St. Thomas's and other hospitals, he started in general practice at Clapham. But his interest was early directed towards public health, for in 1884 he was appointed part-time medical officer of health for Clapham, and took the public health diploma at the University of London. His early reports show the application of scientific principles to the study of disease outbreaks and reveal that he was already making a special study of problems of local and national vital statistics, density of population as a factor in excessive death-rates, and the need for local intensive comparison of death-rates. In 1884 he published a book on "Hygiene", and in 1887 a manual on "School Hygiene".

Newsholme rapidly became a leading authority on public health ; this was recognized by his appointment as whole-time medical officer of health of Brighton in 1888. Here he worked indefatigably and enhanced his reputation as an administrator and a scientific investigator. The writing of "The Elements of Vital Statistics", a standard text-book, led to the offer of the post of medical statistician in the General Register Office, which he declined in favour of Dr. T. H. C. Stevenson. He added to knowledge in his investigations of the epidemiology of tuberculosis, scarlet fever and diphtheria, and in 1895 gave the Milroy Lectures at the Royal College of Physicians on "The Natural History and Affinities of Rheumatic Fever". In these four lectures Newsholme showed that rheumatic fever is an infective disease, that 'explosive' and 'protracted' epidemics occur, that there is evidence of cyclical prevalence, that epidemics can occur in years of minimum rainfall and that the disease varies greatly in extent in different countries. The statistical approach to this and other problems of disease revealed facts of fundamental importance. A statistical study of "The Alleged Increase of Cancer" (with G. King), contributed to the *Proceedings of the Royal Society* in 1895, also broke fresh ground.

In 1908, Mr. John Burns appointed Newsholme as medical officer of the Local Government Board. The State was beginning to see that national health is not solely a matter of environmental hygiene. A beginning had been made with the setting-up of the School Medical Service under the Board of Education, and National Health Insurance was already foreshadowed. In his ten years tenure of office, Newsholme laid the medical foundation of the national health services—tuberculosis, maternity and child welfare, and venereal diseases—as well as making notable contributions to the public health side of the national war effort during 1914–18.

Newsholme was a kind and sympathetic chief ; he worked hard himself and expected his staff to work with equal energy and enthusiasm. He was made a C.B. in 1912 and was advanced to K.C.B. in 1917. With the advent of the Ministry of Health, he retired and accepted an invitation to lecture on public health at Johns Hopkins University in 1920 and 1921. He had a great regard for the peoples of the United States, and closely forged the links of co-operation in

health and social reform between the two nations. This influence is exerting its force to-day.

In the years of retirement, Newsholme's facile pen was seldom idle; and he visited many countries, including the U.S.S.R., to study their health conditions and to discuss their problems. His last two books, "Fifty Years in Public Health" and "The Last Thirty Years in Public Health", are not only autobiographical, but also possess scientific and historical value. Tall, handsome and bearded, with many social gifts, Sir Arthur was a popular figure in Great Britain and the United States. He married in 1881 Sara Mansford, and her death in 1933 was a great blow to him. Newsholme's work as administrator and epidemiologist takes high place in the story of British public health.

ARTHUR S. MACNALTY.

WE regret to announce the following deaths:

Dr. W. S. Bayley, who retired in 1931 from the professorship of geology at the University of Illinois, where he was head of the department, on February 14, aged eighty-one.

Mr. Lionel R. Crawshay, at one time a member of the scientific staff of the Marine Biological Association and for many years research officer, Sponge Fishery Investigations, West Indies and British Honduras, on April 24, aged seventy-four.

Prof. Kurt Huber, professor of experimental psychology in the University of Munich, recently executed for "traitorous conspiracy".

Prof. Martin H. Knutsen, professor of bacteriology at the Pennsylvania State College since 1928, on February 6, aged fifty-five.

NEWS and VIEWS

King's Birthday Honours

THE following names of men of science and others associated with scientific development appear in the King's Birthday Honours list:

Baronet: Sir John Fraser, regius professor of clinical surgery, University of Edinburgh.

K.C.B.: Dr. N. K. Johnson, director of the Meteorological Office.

K.B.E.: Sir T. Franklin Sibly, vice-chancellor of the University of Reading, and chairman of the Committee of Vice-Chancellors and Principals.

Knights: Capt. J. P. Black, managing director of the Standard Motor Co., Ltd., and chairman of the Joint Aero-engine Committee; D. A. E. Cabot, chief veterinary officer, Ministry of Agriculture; Dr. H. L. Eason, president of the General Medical Council; Dr. C. S. Fox, director of the Geological Survey, India; Dr. H. Spencer Jones, Astronomer Royal; J. M. Kennedy, deputy chairman of the Electricity Commission; P. M. Kharegat, vice-chairman, Imperial Council of Agricultural Research, India; E. Macfadyen, chairman of the governing body, Imperial College of Tropical Agriculture; Dr. A. D. McNair, vice-chancellor of the University of Liverpool; Prof. J. L. Myres, formerly Wykeham professor of ancient history, University of Oxford, for services to learning; Prof. G. P. Thomson, professor of physics, Imperial College of Science and Technology.

C.H.: E. W. Hives, for services in the design of aero-engines.

C.B.: J. M. Caie, deputy secretary, Department of Agriculture for Scotland; W. S. Farren, director, Royal Aircraft Establishment, Ministry of Aircraft Production.

C.I.E.: H. Trotter, utilization officer, Forest Research Institute, Dehra Dun.

C.B.E.: R. Chadwick, chief designer and director, A. V. Roe and Co., Ltd.; Dr. H. L. Guy, chairman of the Gun Design Committee, Scientific Advisory Council; Prof. J. Jewkes, deputy director-general of statistics and programmes, Ministry of Aircraft Production; Prof. J. N. Mukherjee, professor of chemistry, University of Calcutta; R. K. Pierson, chief designer, Vickers-Armstrong, Ltd. (Aircraft); Major R. W. Sharpe, chairman, Agricultural Executive Committee, Berwickshire; Lieut.-Col. W. W. Zambra, secretary, Imperial Communications Advisory Committee.

Prof. V. M. Goldschmidt, For.Mem.R.S.

PROF. V. M. GOLDSCHMIDT, whose election to foreign membership of the Royal Society has just been announced, has made outstanding contributions in each of the fields of petrology, crystal chemistry and geochemistry. His early studies in rock metamorphism marked a major advance in the correlation of the chemical and mineralogical composition of thermally reconstituted rocks and contained the first successful essay towards a systematic classification of rock-mineral assemblages in the light of the phase rule. The leader of great schools of geochemistry both at Göttingen and Oslo, Goldschmidt has for many years devoted his attention to the discovery of the principles governing the terrestrial distribution of the elements: in this programme his classical researches on the crystal structure of ionic compounds were early achievements and may be regarded as laying the foundation of the science of crystal chemistry. His exhaustive series of investigations on the chemical composition of rocks and minerals has revolutionized our knowledge of the distribution of the minor constituents of the earth's crust, while his similar studies on meteorites have brought a special contribution to the problem of the chemistry of the earth's deep interior. It is in these comprehensive researches, both geochemical and crystallochemical, that Goldschmidt has contributed in such large measure to the present-day picture of the geochemical evolution of matter within the lithosphere.

Prof. B. A. Houssay, For.Mem.R.S.

PROF. BERNARDO ALBERTO HOUSSAY, of Buenos Aires, elected a foreign member of the Royal Society on May 20, is one of the outstanding men of science of Latin America. He has held the chair of physiology in the University of Buenos Aires since 1919, and has made his laboratory a leading centre for endocrine research. His most remarkable discoveries concern the effect of the anterior pituitary body on carbohydrate metabolism; he showed that although the removal of the pancreas alone will cause diabetes, yet if the anterior lobe of the pituitary is removed at the same time the animal has no glycosuria and stays in reasonable health. Further analysis made it clear that the anterior lobe of the pituitary secretes

a hormone with an opposite effect on sugar metabolism to that of insulin, and that it is the absence of this hormone in the 'Houssay animal' which accounts for the lack of glycosuria when the pancreas is removed. Many other chapters in the complex story of endocrine interactions have been worked out in Prof. Houssay's laboratory and he has recently dealt with the problem of renal hypertension and the nature of the toxic substance which may be liberated by a diseased kidney. He is an honorary member of the Physiological Society and has published various papers in the *Journal of Physiology*.

Prof. T. J. Jehu: Retirement from Chair of Geology at Edinburgh

In his student days T. J. Jehu, who is retiring from the regius chair of geology and mineralogy in the University of Edinburgh, had an unusually varied and distinguished career: at Edinburgh he graduated M.B., C.M. (1893), and B.Sc., with the class medal in geology (1894); at Cambridge he took a first class in both parts of the Natural Science Tripos (1897, 1898) and second class in the Moral Science Tripos (1899). Later, Jehu became lecturer in St. Andrews (1903–14), during which time he served on the Royal Commission on Coast Erosion (1906). In 1914 he returned to Edinburgh as professor of geology; and it was during his tenure of office that the Grant Institute of Geology was founded and endowed.

Jehu's scientific papers have always been of unusual interest, and have mostly appeared in the *Transactions of the Royal Society of Edinburgh*. Until he left St. Andrews, the lakes and glaciation of Wales specially attracted his attention. He sounded the lakes of Snowdonia, and he investigated the interaction of the local and Irish Sea ice in both Pembrokeshire and Carnarvonshire. In 1917 he published a memoir with Robert Campbell on "The Highland Border Rocks of the Aberfoyle District", making an outstanding contribution to our knowledge of the Cambro-Ordovician sequence of the south-east margin of the Scottish Highlands, especially in regard to its palæontology. In 1922 he produced "The Archæan and Torridonian Formations and Later Intrusive Igneous Rocks of Iona". This publication is important in itself, but is now chiefly remembered as a prelude to the "Geology of the Outer Hebrides", which Jehu and R. M. Craig brought out in five parts between 1923 and 1934. It is not too much to say that this serial chronicled the greatest bit of field geology tackled by any British university during the present century. Its outstanding characteristic is its treatment of a belt of flinty crush rock found along the eastern shores of the Western Isles. Here, of course, Jehu and Craig share credit with J. W. Dougal; but plenty remains to ensure for Prof. Jehu in his retirement the warm gratitude of fellow workers in Scottish geology.

Prof. Arthur Holmes, F.R.S.; Appointed to Chair of Geology at Edinburgh

Prof. Arthur Holmes, of the University of Durham, who succeeds Prof. Jehu as regius professor of geology in the University of Edinburgh, has an international reputation in the fields of petrology and geophysics. His name became closely linked with the classic pioneer work on radioactive minerals while he was still a junior member of staff at the Imperial College, South Kensington. He applied this new kind of quantitative data to a re-assessment of the age of the earth, and deduced the approximate period of time spanned by each of the geological ages in sequence—from Pre-Cambrian time to the present day. His contribution to both descriptive and interpretative petrology is voluminous and impressive. His later work incorporates many thought-compelling reviews of conventional hypotheses concerning the thermal history of the earth, the physical state of the earth's interior, the nature and variability of magma, and the origin of igneous rocks. His contributions to geology have profoundly influenced the scope and trend of contemporary work in the field of petrogenesis, and in close co-operation with Dr. Doris L. Reynolds he has in recent years amassed data demonstrating the effectiveness of alkali-metasomatism, transfusion by emanations from deep-seated sources, and granitization—as processes transcending in importance those accommodated within the framework of conventional petrogenetic theory.

U.S. National Academy of Sciences

First Charles L. Mayer Award

Prof. Charles B. Huggins, professor of surgery in the University of Chicago, has been awarded a two thousand dollar prize given by Dr. Charles L. Mayer and administered by the National Science Fund of the U.S. National Academy of Sciences. The award was offered for the "most outstanding contribution made during 1942 to present-day knowledge of factors affecting the growth of animal cells with particular reference to human cancer, and as a new type of prize for the advancement of fundamental scientific research administered under a new type of philanthropic foundation". The award was made to Prof. Huggins for his studies of the human prostate, with special relation to the cancers taking origin from this gland. He has shown that certain hormones which regulate the normal activities of prostatic cells have a marked influence as well on many of the cancers that are derived from them. By the utilization of this knowledge he has been enabled to control the growth of the cancers and of such secondary tumours as may already have formed in distant organs. These discoveries have large theoretical as well as practical implications.

A second Charles L. Mayer award of two thousand dollars for an outstanding study made in the same field in 1943 will be given, and entries and recommendations for consideration for this award should reach the office of the National Science Fund, 515 Madison Avenue, New York City, by January 15, 1944. The Advisory Committee is interested primarily in fundamental studies on the factors influencing growth of animal cells rather than applications to any particular aspect of normal or abnormal growth.

Visual Aids to Education

A small exhibition of visual aids to education was held in the Conference Room of the Board of Education on May 25 and 26. This was organized for the Conference of Ministers of Education of Allied Governments meeting under the chairmanship of Mr. R. A. Butler, president of the Board of Education. The Board has already published a pamphlet dealing with mechanical visual aids. Here the problem was reviewed from a wider angle. The blackboard is the fundamental instrument of visual teaching. The problem of improving illustrated text-books is acute

—the standard is very low. Meanwhile, until films are made to the requirements of teachers, really educational films are hard to get. The position of the sound-film is particularly difficult—facetious commentaries and lack of precise facts are obvious. Many teachers are turning from the film to other aids; of these the strip-film is the most important. In addition to the demonstration of class-room and background exhibitions, the need for making visual material available to the schools was stressed. Much useful material is available in museums, and teachers must be helped and guided in its use. The question of recording all exhibitions in booklet form is important. The Warburg Institute has done valuable work in this direction by means of photographs. Now the Army Bureau of Current Affairs, the Navy and many public bodies are arranging exhibitions, which contain material, facts and ideas of great educational use. Some central organization is needed to preserve this valuable work for educational purposes.

Place of Psychology in the Sciences

ADDRESSING a colloquium of the University of Manchester Branch of the Association of Scientific Workers on May 5, Prof. T. H. Pear explained why in psychology the traditional methods of science are sometimes inadequate. Science has sometimes been defined as measurement and sometimes as organized knowledge of facts, but not all facts can be measured. Moreover, if by facts be meant only events which are in principle open to observation by everyone who wishes to observe them, the psychologist has to study many phenomena, for example, mental images and colour experiences, which are not facts in this sense. Some would claim that they are therefore not amenable to the methods of science, but nevertheless they exist and are important; synæsthesia, for example. Physics has succeeded in maintaining a rigorous scientific method by ignoring certain difficult aspects of experience.

Prof. Pear said that there are few 'inner' inhibitions against analysing or manipulating inanimate matter; more against studying the workings of the human body, and still more against intimate investigation of the mind. He urged the study of individuals side by side with the search for general laws. If this is not to be called science, scientific men should remember that in the case of human beings it may often be the more important study. He concluded by suggesting that the motives of the economist, the politician, of even the man of science, are subjects which interest the social psychologist.

Light and Vision

AT a meeting of the Illuminating Engineering Society following the annual general meeting on May 11, Sir John Parsons gave an address on "Light and Vision". In his opening remarks Sir John recalled his presence at the inaugural dinner of the Society in 1909, and the recognition of the founder of the Society, Mr. Leon Gaster, that its aims were not limited to physical problems, but involved physiological, psychological and æsthetic factors. At that time there was little guidance on lighting matters from the medical side, but engineers had themselves little data, and instruments for measuring illumination were primitive and cumbersome. The first paper read to the Society on glare in 1910 was given by himself, and the Society has since been preoccupied with this and similar problems involving vision. Sir John then discussed the relation between illumination and visual acuity, directing attention to the valuable work of Dr. Lythgoe and others and the development of the Illuminating Engineering Society's Code. Research has established the great importance of background and adequate contrast. The work of Dr. Stiles and others on glare (for which we have no actual physiological test), the effects of specular reflection from polished material and the inconvenience and occasional danger of harsh shadows—most difficult, however, to define with precision—were dealt with. Turning to the colour of light Sir John expressed the view that there is no evidence that artificial sources furnishing so-called 'white light' cause any harmful effects. The injurious effects of ultra-violet light in everyday life have been grossly exaggerated and the craze for 'daylight' lamps has been unwarranted.

Much of the later part of the address was devoted to vision at low illuminations, the peculiar appearance of colours in weak light and the conditions determining the perception of objects at the very low illuminations which are now experienced in the streets in war-time. Reference was made to the work of the Departmental Committee on Lighting in Factories and Workshops, and to the fact that legislation on factory lighting, recommended before the War of 1914–18, has only become a fact during the present War. Sir John referred to the value of the Illuminating Engineering Society Code and the recent researches on this subject by Mr. H. C. Weston, in which an effort has been made to give a scientific background without greatly disturbing the present set of values, which have become standard. The fact that requirements for adequate lighting in factories had now been incorporated in the Factory Act should serve as a precedent for the future, when lighting conditions in schools, offices, etc., might likewise be defined and standardized. The recognition of the I.E.S. Code during the War has been largely due to the fact that it was ready when needed. Now, therefore, is the time to complete codes and specifications relating to other fields of lighting.

Protection of Structures Against Lightning

J. F. SHIPLEY, in a paper read in London before the Institution of Electrical Engineers on May 6, points out that the British Standards Institution has recently issued recommendations on this subject which constitute the first authoritative general guidance made available to the public in Great Britain since the Report of the Lightning Rod Conference in 1881 and its amendment by the Lightning Research Committee in 1905. These new recommendations have been adopted by the Ministry of Works and Planning as its first code of practice, the latter containing additional appendixes in which comment is made on some of the new features dealt with, and which the present paper amplifies to some extent. The paper is confined to problems connected with the protection of modern steel-framed and ferro-concrete structures. The need for protection is discussed and a rough attempt is made to assess the lightning risk attached to any structure in any part of the world. The zone of protection receives attention and the presence of metallic systems in the buildings is mentioned; while the needs of structures which are very vulnerable to lightning, and of others which present difficult problems, are discussed. The components of a lightning protective system, their

materials, dimensions and cost are referred to, and finally inspection, testing and records are dealt with.

More information is needed on the behaviour of large currents of lightning magnitude when earth electrodes of rod and strip in various combinations are used, with various simple soils such as chalk, clay, loam and sand. The influence of bends upon side-flashing when similar currents are discharged through a down conductor is not known exactly, and much more reliable data are required. Another sphere of uncertainty is whether to isolate a lightning protective system or to bond it to the metallic sheaths of other services. The ability of electric conduit to carry a share of the lightning discharge current (as might be the case if bonding were carried out in a very tall building such as a lighthouse) is doubtful, and much more data are needed. The statistical data available from the Meteorological Office on the prevalence of lightning over the major portion of the world will be very valuable, and if the larger British and Overseas fire insurance companies could be induced to provide separate statistics for lightning claims, later recommendations for protection against lightning would be increasingly trustworthy.

Changes in Mortality-Rates in the United States

HAROLD F. DORN, of the United States Public Health Services, states (*Public Health Rep.*, Dec. 4, 1942) that between 1930 and 1940 the expectation of life at birth of the total population of the United States increased from 59 to 63·3 years, an increase of 4·3 years, or 7 per cent. At the beginning of the century, the expectation of life at birth was 49·2 years as compared with 63·3 years in 1939, an increase of 14·1 years or 29 per cent. The relative increase in life expectancy was nearly twice as great for non-whites as for whites. The largest relative decreases occurred in the death-rates of children and young adults, but significant decreases took place throughout life even among the older persons. With the exception of deaths from heart disease, cancer and diabetes, the mortality from each of the important causes of death was lower in 1939 than in 1930. For the first time in the history of the registration area, the maternal mortality-rate declined uninterruptedly throughout the entire decade, the relative decrease being 48 per cent among white mothers and 34 per cent among negro mothers.

Chinese Students for Britain

TEN Chinese students, the first to visit Britain under a new scheme operated by the British Council, are now on their way to Great Britain. They have been given scholarships by the Council, and will study some branch of engineering and will work at the university or college most suited to their special qualifications. Their training is expected to be of special value both because it will equip them for reconstruction work in China, and because their familiarity with British engineering practice and equipment will furnish a link between Great Britain and China.

The names of these students, with their qualifications, are as follow: Shen Yuan (B.Sc. in aeronautical engineering, National Tsing Hwa University, 1940; assistant, National Southwest Associated University, 1940–42; to study aeronautical engineering). Tsao Pung Hyi (B.Sc. in chemistry, National Tsing Hwa University; research student, Research Department of Agriculture, National Tsing Hwa University, 1938–39; assistant, Chemistry Department, National Tsing Hwa University, 1939–42; at Li-Tien Chemical Works, 1942–43; to study chemical engineering). Yuan Sui Shan (B.Sc. in civil engineering, National Tsing Hwa University, 1938; assistant, Civil Engineering Department, National Southwest Associated University, 1938–41; associate engineer, Bureau of Transportation Administration, 1941–42; to study shipbuilding). Meng Ching Yuen (B.Sc. in electrical engineering, National Chiao Tun University, 1938; apprentice, Electrical Administration, Kwangsi, 1939; technician, Ministry of Communications, 1939–40; assistant engineer, Central Electrical Works, 1940–42; to study electrical engineering). Lyn Wei Tze (B.Sc. in mechanical engineering, National Tsing Hwa University, 1940; technician, Fifth Army, 1938–39; assistant, National Southwest Associated University, 1940–42; to study mechanical engineering). Chen Ju Chuan (B.Sc. in chemical engineering, National Chekiang University, 1937; associate engineer, Yunnan Tin Works, National Resources Commission, 1937–39; assistant, Chemistry Department, National Southwest Associated University, 1940–42; to study textile engineering). Lao Ti Li (B.Sc. in chemistry, National Tsing Hwa University, 1940; chemistry assistant, National Central University, 1940–41; chemistry assistant, National Tsing Hwa University, 1942; to study pharmacy). Chang Tse Shuan (bachelor of law, National Tsing Hwa University, 1940; assistant, Economics Department, National Tsing Hwa University, 1940–42; to study planning economics). Fang Pin (B.Sc. in metallurgy, National Yunnan University, 1941; apprentice, Kun-hwa Iron and Coal Works, 1939–40; associate engineer, Yunnan Metal Works, Ministry of Economic Affairs, 1941–42; engineer, Metal Works of Western Yunnan, Ministry of Economic Affairs, 1941–42; to study metallurgy). Prof. Tseou Heou Feo (doctor of science, University of Paris; formerly professor of chemical engineering, National Chekiang University; dean of College of Science, National Szechuan University).

Announcements

THE Minister of Agriculture has appointed Prof. E. J. Salisbury, F.R.S., Quain professor of botany in University College, London, to be director of the Royal Botanic Gardens, Kew, as from September 1.

THE ABBÉ HENRI BREUIL has been elected an honorary Fellow of the Royal Society of South Africa.

DR. ISAIAH BOWMAN, president of the Johns Hopkins University, previously director of the American Geographical Society, has been elected president of the American Association for the Advancement of Science to succeed Dr. Arthur H. Compton, of the University of Chicago. Due to the postponement of the New York meeting Dr. Bowman was elected by postal ballot.

THE following have been elected officers of the Illuminating Engineering Society for the forthcoming session: *President:* Dr. H. Buckley; *Vice-Presidents:* Mr. E. Stroud, Dr. W. M. Hampton and Mr. H. C. Weston; *Hon. Treasurer:* Mr. N. V. Everton; *Hon. Secretary:* Mr. J. S. Dow; *Members of Council:* H. E. Chasteney, E. E. J. Drake, F. S. Ette, J. G. Holmes, W. C. Huston, H. Lingard, J. F. Stanley, J. W. Whitaker and T. Wilkie.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

A Sex Difference in Blood-Group Frequencies

Two or three years ago, when comparatively large bodies of blood-group data were being examined by one of us (R.A.F.), it was noted that at an unexpectedly large number of centres in Yorkshire there were proportionately more women *O*'s than men and more men *A*'s than women.

Subsequent examination of records obtained from various parts of Great Britain has yielded clear, positive evidence in one area, which also proves to be homogeneous in the relative proportions of *O* and *A*. The records are those of the Army Blood Transfusion Service and relate to the six south-western counties of England. In view of this apparently unequivocal finding it seems desirable to place the facts on record, while pointing out that the data for the other areas are an interim summary provided for comparison.

The count in the south-western area included 120,874 donors. The numbers of women and men *O*'s and *A*'s are as follows:

	Women	Men
O	33,042	20,702
A	32,225	20,925

In terms of percentages (ignoring groups *B* and *AB*), 49·37 per cent of women fall into group *A*, compared with 50·27 per cent of men. Testing for homogeneity by means of a 2 × 2 comparison, χ^2 equals 8·086 (using Yates's correction for continuity). Thus the chance of obtaining two such diverse samples from homogeneous material is no more than one in 450.

The difference, taking the material as a whole, is highly significant, but it is important to examine the homogeneity of its constituent parts. Population movements or concomitant variations in sex-ratio and the relative proportions of *O* and *A* might create false associations. The records from the six counties were tabulated separately for nine areas centred on the towns named in the table below. (It should be explained that the high proportion of men in the Cheltenham area is due to the inclusion of many employees of the Great Western Railway Company at Swindon.)

Area	Women		Men		Sex difference in per cent $A/(A+O)$
	O	*A*	*O*	*A*	
Cheltenham	4,049	3,775	4,760	4,876	+ 2·35
Bristol	10,283	10,237	7,656	7,747	+ 0·41
Salisbury	2,045	2,119	786	802	— 0·49
Dorchester	1,257	1,228	594	527	— 2·41
Bridgwater	4,392	4,197	2,492	2,487	+ 1·09
Exeter	6,279	6,132	2,146	2,193	+ 1·13
Plymouth	316	276	74	96	+ 9·85
Barnstaple	2,577	2,510	1,036	1,074	+ 1·56
Truro	1,844	1,751	1,158	1,123	+ 0·52
Total	33,042	32,225	20,702	20,925	+ 0·90

The area is not significantly heterogeneous in the proportions of *O* and *A*, either in the case of the total figures or in either sex separately. Making a 2 × 9 comparison, χ^2 equals 13·284 in the case of the women, 9·488 in the case of the men, and 13·566 in the case of the totals. The corresponding values of *P* are 0·10, 0·30 and 0·09.

In view of the homogeneity in the proportions of *O* and *A*, it is sufficient to examine the homogeneity of the sex difference throughout the area by calculating χ^2 separately from each of the nine 2 × 2 tables, summing and deducting the χ^2 for the total. The remainder, corresponding to 8 degrees of freedom, represents heterogeneity.

The result is as follows:

	Degrees of freedom	χ^2	*P*
Sum for nine areas	9	21·096	0·012
Total for whole area ..	1	8·086	0·0045
Difference attributable to heterogeneity	8	13·010	0·111

There is no significant heterogeneity, therefore, within the area in respect of the sex difference.

It is unlikely that population movements could produce this difference in such a large and homogeneous area. There is, however, a stronger argument. Only movement into (not out of) an area of persons of different blood-group frequencies, a movement unequal as between the sexes, could produce such an effect. Men migrate more than women and as this area is already as high in *A* as any other part of the British Isles, it follows that a movement of population into it would tend to lower the proportion of men *A*'s, the reverse of the effect observed.

The Yorkshire data, divided into eleven areas, are shown in the accompanying table.

Area	Women		Men		Sex difference in per cent $A/(A+O)$	Weight
	O	*A*	*O*	*A*		
Bradford	7,218	6,165	4,165	3,596	+ 0·26	1·97
Halifax	2,178	1,995	1,342	1,265	+ 0·72	0·64
Huddersfield	1,860	1,542	1,385	1,264	+ 2·39	0·60
Leeds	7,438	6,294	3,921	3,511	+ 1·41	1·93
Sheffield	7,811	7,238	7,119	6,793	+ 0·73	2·89
Wakefield	1,692	1,522	1,431	1,269	— 0·36	0·59
Hull	4,272	3,648	2,595	2,135	— 0·92	1·18
East Riding	1,284	1,040	645	580	+ 3·02	0·32
Vale of York	2,654	2,318	1,599	1,408	+ 0·20	0·75
West Riding excluding Skipton and Settle	13,375	11,081	10,031	8,407	+ 0·19	4·20
Skipton and Settle district of West Riding	1,353	1,075	755	616	+ 0·66	0·35
Total	51,135	43,918	34,988	30,854	+ 0·51	15·42

In every district save two, Wakefield and Hull, the proportion of *A*'s is higher among the men than among the women. As there are in this region considerable geographical variations in the relative proportions of *O* and *A*, and also large variations in sex ratio, a comparison of the totals alone might well be misleading. Consequently, a weight has been calculated for each area, using:

$$w = 0{\cdot}0004 \div \left(\frac{1}{N_1} + \frac{1}{N_2}\right),$$

for N_1 women and N_2 men. The weighted mean difference calculated in this way is 0·51 per cent compared with 0·90 for the West Country data. The eleven districts are perfectly homogeneous for sex difference, χ^2 being less than 10 for 10 degrees of freedom, and the average difference is significant beyond 1 in 20, or 1 in 40 if direction is taken into account. Had the total figures been thrown together, the inflated differ-

ence of 0·66 per cent would have considerably magnified the apparent significance of the sex difference.

A series of 7,322 *O*'s and *A*'s from Coventry yields women 47·609 per cent, men 51·008 per cent, a difference consistent with that found in the larger samples, but scarcely consistent with zero difference. Wolverhampton, with 6,379 donors, gives a similar result, but certain discrepancies in the case of these figures make it safer not to rely upon them at present.

A large and undoubtedly reliable sample obtained by Dr. Janet Vaughan at Slough, and counted from time to time at the Galton Laboratory, shows no sex difference in the ratio $A : (A + O)$. Among 70,000 donors, we find women 49·604 per cent and men 49·355 per cent. The women are thus slightly higher in *A*, the difference being non-significant. This result is in definite conflict with those of south-west England and Yorkshire. It is possible, however, that the absence of a sex-difference is to be ascribed to population movements, for it cannot be doubted that the London area, above all others, constantly receives from Scotland, Ireland, Wales and the north an influx of immigrants with a lower percentage of *A*, and a preponderance of men.

As the evidence stands, then, the difference is highly significant in south-western England and moderately significant in Yorkshire, while some supporting evidence is provided in the Midlands by Coventry, and possibly by Wolverhampton. The large sample from Slough is in definite disagreement, though a reasonable explanation can be offered for the discrepancy. Whatever the explanation may be found to be, we feel that the empirical evidence has now accumulated to a point at which its indications must be recognized.

We wish to thank Brigadier L. E. H. Whitby and the staff of the Army Blood Transfusion Service, especially Major B. Lacey, Captain T. Fortescue Fox and Mr. R. J. McCrudden for the excellent facilities so readily placed at our disposal. We are also greatly indebted to Dr. M. S. Stanbury for access to the Yorkshire forms.

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Hexose Dehydrogenase

EXPERIMENTS on a hexose dehydrogenase have been in progress in this laboratory since November 1940, and many useful data have been collected. A recent communication[1] makes it desirable to publish the results so far obtained.

The most potent preparation of the enzyme has been obtained from *Phaseolus mungo* and *P. radiatus* seeds. The enzyme has also been found in the small intestines of animals, including the guinea pig. The aerobic and anaerobic dehydrogenation of the hexoses by the enzyme produces ascorbic acid, as found by titration with 2 : 6 dichlorphenol indophenyl under suitable conditions. The enzyme is equally active towards glucose, galactose and mannose; but fructose and sorbose are not as good substrates as the other three sugars. Fructose and sorbose are, however, converted to ascorbic acid, to a smaller extent, by the enzyme. The disaccharides and the pentoses cannot act as substrates. Thus it would appear that the enzyme is an aldohexose dehydrogenase. The enzyme preparation from the germinating legumes produces both ascorbic acid and dehydroascorbic acid, owing to the simultaneous presence of the oxidizing enzyme (ascorbic acid oxidase), while the enzyme from the small intestines of animals produces ascorbic acid only.

The optimum *p*H for the enzyme is 6·5. Potassium cyanide in concentrations of 20 mgm. per cent or more, but not hydrogen sulphide, is an inhibitor of the enzyme. Manganese has been found to be the co-enzyme of the dehydrogenase. The addition of the manganese ions in suitable concentrations not only activates the enzyme but also, after electrodialysis of the enzyme extract, synthesis of ascorbic acid takes place only on the addition of manganese. Nickel is very slightly active in this respect, but magnesium, copper and iron are inactive.

The enzyme preparation from the germinating legumes was made by grinding the germinated seeds with cold water, centrifuging and filtering the clear extract through ashless filter paper. From the small intestines, the enzyme extract was made by extracting the acetone-dry intestines with water at 0° C. for 2–3 hours, centrifuging and filtering. 1 c.c. of the enzyme extract was incubated with 1 c.c. sugar solution (25 mgm.) and 3 c.c. phosphate buffer of *p*H 6·5, 1 c.c. of distilled water replacing the sugar solution in the control. Time of incubation was 3–4 hours. A few results are given in the accompanying table.

Source of enzyme	% Mn in incub. mix.	Ascorbic acid synthesis (mgm./gm. original sub.)		
		Undialysed enzyme extract		Electrodialysed extract
		in air	in nitrogen	
P. mungo	nil	0·08	—	nil
,,	0·001	0·20	—	—
,,	0·005	—	—	0·12
P. radiatus	nil	—	—	trace
,,	0·001	—	0·17	—
,,	0·001	—	—	0·11
Rat intestines	0·005	—	—	0·02

It is evident that on electrodialysis the activity of the enzyme is inhibited slightly, or that some unidentified activating substance is lost. Manganese acts in association with some protein carrier. The protein is probably an albumin. Some evidence for this has been obtained by examining the activity of albumin – manganese mixtures.

The enzyme is partly precipitated by acetone but attempts to prepare a highly active enzyme in this way have not been successful; the preparation of a stable and highly active dry enzyme is under investigation.

Nov. 15, 1942 [delayed in transmission].

[1] Baser and Karkum, Proc. 29th Ind. Sci. Congress, Pt. 4, 5 (1942).

IT has been shown [above] that the enzyme preparation from acetone-dry small intestines of animals can synthesize a comparatively small amount of ascorbic acid. The probable explanation is that the enzyme is denatured by acetone treatment. This is suggested by the fact that the enzyme preparation obtained by extracting the fresh jejunum of the goat and guinea pig shows synthesis of a greater amount of ascorbic acid. Four hours incubation of the enzyme extract with glucose at *p*H 6·5 and in presence of added manganese produces the following results.

Source of enzyme	% Mn in incub. mix.	Ascorbic acid synthesis (mgm./gm. fresh tissue)	
		Without dialysis of enzyme extract	After electro-dialysis of enzyme extract
Goat jejunum	nil	0·02	0·01
" "	0·004	0·06	—
" "	0·01	—	0·06
Guinea pig jejunum	nil	0·015	nil
" " "	0·005	—	0·035

The protein fraction precipitated at *p*H 5·7 is inactive, but attempts to concentrate further the enzyme by separating the globulin fraction failed because both the globulin fraction and the albumin fraction partially retained the enzymic activity. It also appears that the coenzyme (Mn) is more firmly attached to the enzyme in animal intestines than in the germinating grains. In the latter, electrodialysis for half an hour of the enzyme extract suffices to inhibit the activity, while in the former, even an hour fails to arrest the activity completely.

The investigation is proceeding.

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Flocculation of Bacteria by Protozoa

IN view of the recent discussion[1,2] of the possible importance of certain Protozoa in the flocculation of bacteria in sewage sludge, it may be of interest to record a clear-cut instance of flocculating activity on the part of a protozoan.

The ubiquitous freshwater and soil flagellate *Oikomonas termo* Kent, when grown in two-membered culture with various bacteria, has been observed to cause a very marked flocculation of certain species, notably *Erwinea carotovora*, *Erw. phytophthora*, *Proteus vulgaris*, *Phytomonas tumefaciens* and one strain of *Escherichia coli*, to use the nomenclature of Bergey's "Manual"[3]. The medium used for these mixed cultures contained 0·2 per cent glycerol, 0·1 per cent Difco proteose peptone, and 0·02 per cent each of calcium chloride and magnesium chloride. In tubes containing 10 ml. of this medium, flocculation usually occurred within three or four days after the introduction of small inocula of the bacteria and the protozoa. Microscopically, each of the flocculs was seen to consist of a large central mass of bacteria with a few flagellates attached at the periphery. The maximum diameter of these flocculs was about 3 mm.

Since both the bacterial and the protozoan cultures[4] used for the inoculations were pure cultures, and since the bacteria when grown alone in this medium flocculated very slightly, and then only in old cultures, there can be little doubt of the causal significance of the protozoan. The mechanism of the flocculation has not, however, been investigated.

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Long-Chain Molecules in Aqueous Urea Solution

FRICTION between surfaces is normally either of the (*a*) continuous or (*b*) stick-slip type. Occasionally, however, as in the determination of the viscosity of ammonium oleate solution by means of the concentric cylinder method, a new type (*c*) is encountered provided the shearing-rate is sufficiently low. In this, chain-like micelles cause adhesion between the surfaces, this adhesion being then periodically broken down with violent movements.

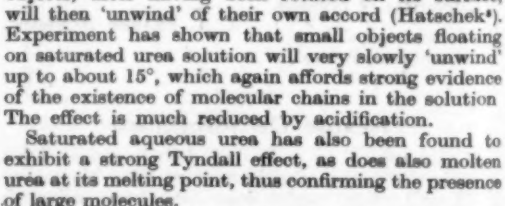
In the course of some experiments on friction utilizing an apparatus similar in principle to that previously described[1], in which a tungsten wire attached at its two ends by springs is half wrapped round a rotating 'Perspex' wheel partly immersed in a liquid, it has been found that friction of types (*a*) and (*b*) is encountered with by far the greater proportion of the aqueous solutions so far investigated. A solution of ammonium oleate exhibiting anomalous viscosity, however, gave rise to violent periodic movements of the wire (friction of type *c*). Using this apparatus, it has been found that while 2 per cent aqueous urea gives friction of type *a*, 20 per cent gives type *c*. The violent oscillations thus caused are sensitive to *p*H changes, being completely stopped by a few drops of dilute acetic acid.

The occurrence of *c*-type friction may most readily be explained on the hypothesis that strong urea solutions contain chain-like molecules which collect together to give fibrils of considerable mechanical strength. The formation of chains is not unlikely in view of the fact that hydrogen bonding is known to occur with complex substituted ureas in monolayers and to be destroyed by acidification (Alexander[2]). It would appear that the simple apparatus used in this work, of which it is hoped to publish further details shortly, may prove of value in detecting chain molecules in solutions. A similar effect has also been observed in the case of a saturated solution of glycine.

A solution exhibiting anomalous viscosity often shows the properties of a weak solid, so that floating objects, after having been rotated on its surface, will then 'unwind' of their own accord (Hatschek[3]). Experiment has shown that small objects floating on saturated urea solution will very slowly 'unwind' up to about 15°, which again affords strong evidence of the existence of molecular chains in the solution The effect is much reduced by acidification.

Saturated aqueous urea has also been found to exhibit a strong Tyndall effect, as does also molten urea at its melting point, thus confirming the presence of large molecules.

If, as seems likely (Pauling[4]), hydrogen bonding creates a new very large dipole moment, it is possible that, bonding having once started, a chain will continue to grow in length through the solution so that finally, although most of the molecules may be monomeric, a small proportion may be very highly associated. Numerous formulæ for such chain molecules are possible, the following being, perhaps, as likely as any :



In such a chain, on Pauling's view, there would exist a series of dipoles, while the two ends of the molecule would be charged. The intermediate dipole charges would cause strong lateral attraction between similar chains displaced a few Ångström units with respect to one another, while the end charges may serve to attach the chains to solid objects or other similar interfaces. In this way the *c*-type friction and the Hatschek effect find a ready explanation.

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A New Type of Complex Silver Compounds with Tervalent Silver

IN course of a series of investigations[1] in this laboratory on the complex compounds of biguanide and substituted biguanide with metallic elements, recently my pupil, K. Chakravorty, and I, have obtained a number of 4-co-ordinated silver ethylenebiguanide salts in which the central silver atom shows, rather strikingly, a primary valency of three. Their composition is given by

$$[Ag^{III}(EnBigH)_2]\,X_3,$$

where X is SO_4, NO_3, ClO_4, or OH; and EnBigH is one molecule of ethylenebiguanide ($C_4N_8H_8$), which behaves as a chelate or bidentate molecule. The salts form beautiful, needle-shaped, prismatic crystals of deep red colour and are quite stable at ordinary temperature (20°–24° C.). The nitrate can be recrystallized from warm dilute nitric acid. The colour of the base is dark violet-red resembling that of potassium permanganate.

From an acidified solution of potassium iodide the complex ion liberates *two* equivalents of iodine for every silver atom. The molecular conductivity of the nitrate at 20° C. is 455 ohms^{-1} at infinite dilution, as would be expected for a tervalent complex ion. The salts, unlike those of bivalent silver, are *diamagnetic*.

The electronic configuration of a tervalent silver atom should be similar to that of bivalent nickel, just as bivalent silver is analogous to bivalent copper. Hence it is not at all surprising that the four-co-ordinated tervalent silver complex shows diamagnetic character, if the co-ordination bonds be of the hybrid d-s-p^2 type as in the corresponding planar bivalent nickel complexes. In fact, the diamagnetic property of these complex salts furnishes a strong confirmation of the tervalency of silver in them. That a tervalent silver gives a co-ordination number of four, and not six which is the characteristic of a large number of other tervalent ions, is quite in keeping with its position between copper and gold in the same group of the Periodic Table. A tervalent gold, as is well known, shows consistently a co-ordination number of four with planar configuration. There is, therefore, nothing unusual in that the silver atom shares the character of both copper and gold, becoming uni-, bi- and tervalent respectively.

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[1] Rây and co-workers, *J. Indian Chem. Soc.*, 671 (1937); 347, 350, 353, 633 (1938); 621, 629, 617 (1939); 217, 289, 298, 609 (1941); 1 (1942).

The Concept of Polygenes

IN spite of Waddington's[1] clear statement to the contrary, the recent correspondence[2,3] on polygenes tends to create the impression among biologists who are not geneticists that polygenes are a new development. It is worth pointing out, therefore, that not only is the concept traceable to Mendel himself, but that the very word "polygene" (equivalent to the English adjective) appears to have first been used extensively by Plate in his 1913 text-book[4]. The word did not meet with general approval at the time, and indeed objections against it very similar to Waddington's[1] were made by that pioneer of quantitative inheritance, Johannsen[5]. Thus on page 669: "Darum ist es auch unzulässig von 'monogenen' oder 'digenen' Merkmalen, als Gegenstück zu (polygenen) Merkmalen zu reden, wie Plate es neuerdings tut. Selbst im populären Abhandlungen dürfen solche prinzipiell unrichtige, eigentlich nur auf Zufälligkeiten der unvolkomenen Kreuzungsanalysen sich beziehende Ausdrücke nicht verwendet werden, weil sie ja nur verwirren können. Es steckt darin ein Rest veralteter Vorstellungen über 'Merkmahle' und deren einheitlich 'Anlagen',—wir müssen aber wirklich aus dem Banne diese Konzeption heraus", and a similar paragraph on p. 561.

Such words are at times convenient, and if their use is not to be accompanied by the kind of misunderstandings mentioned by Waddington[1] it is essential that the underlying fallacies be clearly seen. As the last-named author points out, the fallacy in the use of the nouns polygene and oligogene is the disregard of pleiotropic gene action. The corresponding adjectives imply a converse fallacy, namely, that characters are determined by one gene only.

As Mather[3] states, his point of view differs from that of Nilsson-Ehle. It is, in fact, much more similar to that of Johannsen and of a number of others. Present-day work only differs from that of these early pioneers by its insistence on natural selection and by the idea that linked complexes will be built up through its operation, an idea put forward by Fisher[6]. The actual experimental demonstration of linked complexes is still in its infancy.

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RESEARCH ITEMS

History and Ethnology of the Caddo Indians

THE Caddo Indians, of whom very little has been written, were a group of tribes of great importance in the earliest days of which there is historical record in America, that is, in the first half of the sixteenth century. But they have been almost lost to sight and their significance underrated because they lived in a portion of the country beyond the Mississippi that was not under the control of the United States. The early records of this stock are in Spanish and French, and by the time the United States took over the territory these Indians were scattered and their culture practically destroyed. The assembling, therefore, of the materials for this study was of great importance, and the results (John R. Swanton, *Bull.* 132, Bur. Amer. Ethnology, Smithsonian Inst.) form a valuable addition to the literature dealing with the American Indian.

Death-rate Variation in Fowls and Geographical Latitude

IN order to study the rate of embryonic mortality in fowls and factors determining it, investigations were made at the Moscow Institute for Poultry Breeding by E. Penionzhkevich (*C.R. Acad. Sci. U.R.S.S.*, 32, No. 8; 1941) on 61 million eggs from 369 farms situated in latitudes ranging from 42° to 62° N. It was found that the embryonic death-rate increases (that is, the hatching-rate decreases) with latitude, and the regularity holds good for two consecutive years, the difference in the mortality-rate averaging 6 per cent. When the mortality-rate was analysed with regard to the stage in the embryonic development, it was found that the increase of mortality in more northern latitudes is particularly due to the environmental influence, not in the first seven days of development, but during the following period up to hatching. The rate of embryonic mortality, according to the author's theory, is due to the influence of the environment not on the egg itself but on the maternal organisms.

Identification of Clostridia of Gas Gangrene

G. F. Petrie and D. Steabben (*Brit. Med. J.*, 1, 377; March 27, 1943) have shown that colonies on agar plates of the three chief pathogenic clostridia of gas gangrene—*Cl. welchii*, *Cl. septicum*, and *Cl. œdematiens*—can be identified with certainty if the corresponding antitoxin is added in an optimum amount to the basal medium, which is chosen as one that favours production of the specific toxin. During anærobic incubation the toxin diffuses from the colony and interacts with the antitoxin to produce an easily recognizable precipitate, which resembles a halo round the colony and which consists of toxin-antitoxin aggregates linked together. This precipitate tends to form concentric (Liesegang) rings that are so characteristic as to leave no doubt of the identity of the associated bacterial species. In the authors' view the most likely explanation for the appearance of concentric zones is that the forces which combine to build up the framework of molecular aggregates as a uniform deposit to the naked eye are not in equilibrium, and that at a later stage stresses or strains in the structure result in condensation of the precipitate in the form of annular zones separated by clear zones. The remarkable symmetry of the concentric zones is evidence that the molecular aggregates which constitute the toxin-antitoxin precipitate within the matrix of the agar gel are disposed in an ordered arrangement and that the forces controlling them are in equilibrium. The method may prove to be useful in the investigation of the anærobic flora of wounds and for the diagnosis of gas gangrene in time of war.

Alighting-Boards and Colour-sense in Bees

THE *Bee World* of March 1943 contains a translation of an article by Dr. Ruth Lotmar, published in the *Schweizerische Bienenzeitung* of October 1942, entitled "Painted Alighting-Boards and the Colour-Sense of Bees". The use of coloured alighting-boards is advocated as a measure for preventing excessive drifting of bees which may result in the carriage of disease from infected to healthy stocks. It appears desirable, therefore, to enable the bees to find their own hives more readily by marking the alighting-boards distinctively. In order to do this to best advantage, it is necessary to make full use of the available knowledge regarding the colour reactions of bees. It is recommended that the following principles be observed in painting alighting-boards. Strong dark colours should be used. Although bees are red-blind, colours with red in them can be used. Thus, cinnabar and purple-red can be used because these colours appear to the bees as dark brown and dark blue respectively. They should not be used, however, to compete with alighting-boards painted with the last-named colours. If white paint be used it is desirable to adopt as pigment zinc white in preference to white lead. White surfaces, seemingly alike to human vision, may look very different to bees according to the amount of ultra-violet in their composition. Thus, the artist's pigment white lead which scatters much ultra-violet appears white or pale grey to bees. But zinc white, Titan white, etc., scatter little or no ultra-violet and are seen by bees as intense blue-green. It is the latter type of white that is to be preferred. Since bees are able to distinguish between different degrees of brightness of a given colour, different tones of the colour may be used but it is preferable that two neighbouring hives be painted in different colours. While young bees, leaving the hive for the first time, often drift into neighbouring stocks, their return to their own hives can be made much easier by the suitable painting of the alighting-boards.

Head Musculature of Coleoptera

UNDER the title "The Musculature of the Labrum, Labium and Pharyngeal Region of Adult and Immature Coleoptera", C. K. Dorsey contributes a detailed morphological study which forms No. 7, vol. 103, of the *Smithsonian Miscellaneous Collections* (January 1943: Publication 3,697). The object of this study is to discover the arrangement of the muscles of the parts concerned and their bearing upon the process of food ingestion: also it is intended to serve as a contribution towards determining muscle homologies between different groups of insects. The author concludes that it is difficult and often impossible to identify corresponding muscles on a functional basis. A muscle, for example, may be an adductor in one species whereas its homologue in another species is perhaps a retractor because of some slight change in the position of the point of insertion. It is considered for this reason that the general application of functional names to insect muscles is limited. The 24 plates illustrating this paper com-

prise 134 figures of the muscles concerned in a very wide range of Coleoptera and their larvæ. The Leng system of classification as modified by Böving and Craighead is followed, and at least one family from each superfamily selected from which a genus is chosen for study. When possible, the immature stage of the same genus is used.

Early Collections of Arctic Plants

BETWEEN the years 1819 and 1825 three voyages were made by Parry in search of the North-West Passage. On all these expeditions Parry and his officers made collections of plants. While some of these were intended for institutions and have long been available for consultation, other sets were probably made up for presentation to personal friends. Four small sets, perhaps all of which belong to this category, form the subject of an article by Dr. N. Polunin (*North Western Naturalist*, Sept. 1942). Three of the sets are in the Manchester Museum and one at the University of Durham. There is evidence that W. J. Hooker and Robert Brown, in preparing their accounts of the botany of the areas covered by the expeditions, had not seen all these collections, though the additional records which they furnish have been reported by later collectors. Three of the collections appear to have been made on Parry's third voyage; the remaining one, though labelled as coming from the first voyage, contains some species which were almost certainly collected on the second. Except for one set the collections are of little value for purposes of phytogeographical citation owing to the absence of localizations on the individual sheets. The most interesting species represented is *Salix polaris*. There is no satisfactory evidence for the occurrence of this species in the Canadian Arctic Archipelago, and in view of Parry's visits to other Arctic regions where the species abounds it cannot be safely admitted on the basis of this unlocalized specimen.

Autonomic Leaf Movements and Water-Balance in the Plant

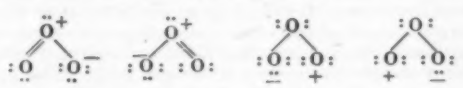
THE half-yearly *Journal of the Mysore University* (3, No. 1, September 1942) contains some interesting observations by C. V. Krishna Iyengar on autonomic leaf movements and their relation to the water-content of the plant. They were studied particularly in *Desmodium gyrans*, *Mimosa pudica* and a species of Impatiens, but such autonomic movements are seen not only in these plants but also in many leaves with or without pulvini. The petiole shows the movement whether the lamina is present or removed, and the direction and rate of leaf movement resulting seem to be determined by the water content of the plant. Experiments indicated the occurrence of movements due to major and minor fluctuations in the water balance, major fluctuations occurring at intervals of 10–20 minutes, minor at shorter intervals of one minute or less.

Flame Spectra in the Photographic Infra-Red

THE spectral region between 7,000 and 10,000 A. has been neglected owing to the weakness of flames as sources and the slowness of photographic plates in this region. A. G. Gaydon (*Proc. Roy. Soc.*, A, 181, 197; 1942) has photographed in the range 6,000–10,000 A. the spectra of the flames of hydrogen, methane, and carbon monoxide burning with oxygen and with nitrous oxide. All flames in which water is a final product show a system of emission bands from the red to the far infra-red, the bands increasing in strength to longer wave-lengths. Outstanding bands were identified as due to the vibration-rotation spectrum of H_2O. The top of a flame of oxygen burning in hydrogen is coloured red by the emission of these bands. In the hydrogen flame the bands are probably excited mainly thermally, but the strength of these same H_2O bands in the flame of moist carbon monoxide indicates that in this flame the excitation is a result of the combustion processes. In the hydrogen – nitrous oxide flame, new band structure in the infra-red is provisionally assigned to an extension of the ammonia α band. The methane–nitrous oxide flame also shows the ammonia α band, and in addition strong emission of the red system of CN.

Molecular Structure of Ozone

DISCUSSION has recently centred about the question whether the ozone molecule is triangular or a bent rod. The angle proposed for the bent molecule has varied from 38° to 140° and the interatomic distance from 1·13 to 1·29 A. An investigation of the electron diffraction of ozone by W. Shand and R. A. Spurr (*J. Amer. Chem. Soc.*, **65**, 179; 1943) leads to the conclusion that the molecule is in the form of an isosceles triangle with the O to O bond distance $1{\cdot}26 \pm 0{\cdot}02$ A. and the O—O—O angle $127° \pm 3°$. Resonance between the structures:



is assumed, although the angle is slightly larger than would be expected. The angle recently calculated by C. P. Smyth and G. L. Lewis (*J. Amer. Chem. Soc.*, **61**, 3063; 1939) is much larger, 140°, and in a note added to their paper, Shand and Spurr mention that Mulliken has recently favoured, from spectroscopic evidence, a triangular molecule with the angle of 39°. It would seem that the structure of ozone is still problematical.

Rare Earths

A CONVENIENT method for the separation of ytterbium from the neighbouring rare-earth elements is described by J. K. Marsh (*J. Chem. Soc.*, 8; 1943). A hot solution of ytterbium acetate on treatment with sodium amalgam was first reduced to an orange-yellow solution containing bivalent ytterbium, and then ytterbium amalgam was formed. The reaction is almost quantitative. The neighbouring elements are devoid of amalgam-forming power. After treatment of the amalgam with acid and precipitation and ignition of the oxalate, ytterbium oxide spectroscopically pure was obtained. The purification of a lutecium preparation by removal of ytterbium as amalgam, in presence of added samarium acetate, is described. The same author (*ibid.*, 40) describes some yttrium group oxalates. In the cerium group the common oxalate is the 10-hydrate, but some 9- and 11-hydrates are known. In the yttrium group the recorded results are more diverse, but 6-, 10- and 17-hydrates of yttrium oxalate have been prepared, the first two being new, and the last peculiar to yttrium. The 9-hydrate reported is actually a complex ammonium salt. The 6-hydrate of ytterbium oxalate was prepared.

SEWAGE TREATMENT IN A TROPICAL CITY

By DR. LL. LLOYD
University of Leeds

MR. N. V. MODAK has given an account of the operation of a sewage purification plant at Dadar, Bombay, the first city in India to operate such works under skilled technical and scientific supervision with the requisite laboratory control (Presidential Address, Section of Engineering and Metallurgy, 30th Indian Science Congress, Calcutta, 1943). The works, constructed in 1934, receive 10 million gallons a day, of which half is fully treated and the rest passed into the storm channels after settlement, the War having prevented proposed extension. The plant includes a Simplex activated sludge system, an enclosed bacteria bed with forced aeration and a sludge digestion chamber with gas recovery. It has been in operation sufficiently long for certain peculiar problems of sewage purification in the tropics to be realized. Special difficulties are experienced in dealing with the grit and with the septicity which prevails at all seasons in the initial tanks and readily develops in the later parts of the system.

The sewage contains road grit only after great storms, but the general habit of scouring pans with ashes and dust introduces a steady quantity of grit into the domestic sewage. A fault in design complicates the matter, for the screens are down flow from the grit chambers and so the inorganic matter becomes inextricably mixed with rag, fæcal material and cellulose waste to the extent of 40 per cent. The grit in the most septic state has to be removed four to six times a day, as opposed to the English practice of after storm. The material removed is an offence and a source of fly breeding (these flies will include the dangerous domestic species) and as no means of washing or incineration are available, it has to be transported far from the city.

The prevailing septicity complicated the operation of the sedimentation tanks. Detention in hopper-bottom Dortmund type tanks could last only 1½ hours (a general minimum of 8 hours is desirable) and the tanks had to be desludged every two hours in dry weather, every four hours in wet weather. In England a weekly cleansing suffices. A radial flow circular tank gave rather better results, but the scraper had to work continuously instead of the normal intermittence to prevent the septic solids from adhering to the sides. No chemical treatment was afforded at any stage. Judicious chlorination after the screens might have counteracted the tendency to putrefaction and simplified later operations.

It took about a year of experiment and adjustment to obtain satisfactory results from the activated sludge plant. Septicity was again a difficulty, as attempts to consolidate the sludge for injection rendered it corrupt. In the sequel the injected sludge contained 99·5 per cent water as against a normal 98·5 per cent. The volume of surplus sludge was enormous, 2 million gallons a day being produced from the 4 million gallons a day flow. This difficulty was overcome by devoting six tanks (out of eighteen) to consolidation for a 6-hour period, by means of which the sludge for disposal was reduced to a twentieth of its bulk. Mr. Modak claims that this is an innovation worthy of general adoption. The fauna typical of high-quality activated sludge developed only during the monsoon, though the system seems to have given fair results once the local conditions were mastered; but it was hypersensitive.

The enclosed percolating filter with forced draft is of particular interest as such plant is still a novelty. The design is calculated to reduce stench and fly escape, a matter of the greatest importance where intestinal diseases are rife. The filter was 78 ft. 6 in. in diameter and 7,000–12,000 cu. ft. of free air per minute was driven in through the cone-shaped roof. Windows were provided but proved useless owing to sewage spray and resulting growths. Internal lighting was therefore installed. The filter was 12 ft. in depth (against a normal 6 ft.) with the idea that more work would be done in a restricted area (but modern belief is that the main purification takes place in the topmost foot and stabilization through nitrite to nitrate below). Actually, nitrate never developed and it is likely that the normal 6 ft. depth would have given equal results. The expectation was that the filter would deal with a flow of 2 million gallons a day, but it would cope with no more than half this load. At the higher flow it went out of action with the loss of its scouring fauna, and then would not deal with 1 million gallons a day but had to be stopped, cleaned and restarted *de novo*. The scouring fauna consisted of earthworms, small wriggling pink worms (probably enchytræid) and the usual psychoda flies. Several slight modifications are suggested mainly to reduce escaping odours. Work inside such a chamber in the tropics, the inevitable cleaning of the tubes and jets, must be the intensest strain.

This enclosed filter is preferred for Indian conditions to the activated sludge system for the following reasons: (1) It requires 15–18 h.p. per m.g. whereas activated sludge process requires 28–35 h.p. per m.g. (2) The mechanical attention required is much less and the mechanism is less complicated. (3) Skilled supervision is not constantly required due to non-sensitiveness. (4) Manual labour required for its upkeep is less. (5) For equal capacity plants the area required for an enclosed filter is almost half of that required for activated sludge plant.

The sludge digestion chamber yielded 60,000 cu. ft. per day (0·7 cu. ft. per person contributing; 65 per cent methane). Only 25 per cent of this output was utilized and the rest burnt, though some useful outlet for the surplus is being sought. In this connexion the present writer has wondered whether it would be feasible to utilize recoverable gas for steam-pressing sludge. Sludge is a valuable fertilizer, but is intractable because of its water content with which it will not readily part, and vast quantities are dumped into the sea or spread in barren lagoons to the waste of valuable land. So we fritter away our heritage. Sometimes it is cold pressed, but the product is in lumpy cakes and though accepted as fertilizer it is difficult to spread and disintegrate. At the Esholt Works of Bradford City Corporation, sludge is steam pressed for the recovery of grease from the wool washings, part of the recovered grease being utilized to raise steam. The resulting material is not sludge but a friable humus of sufficient value to be shipped in considerable quantities to France and even Palestine for horticultural manure. Such steam pressing would render tropical sludge safe for truck crops whereas it is dangerous untreated, for the eggs of intestinal helminths must remain viable during passage through the works and some species remain viable for years. At Dadar little sludge is utilized for manure, the amount sold being valued at only Rs. 100 in the year.

Mr. Modak's important address suggests several lessons. Bombay has gone ahead of some of the seaside resorts of Great Britain, where it is still the practice to pour untreated sewage into the sea, to the fouling of the foreshore and the discomfort and danger of bathers—although some visitors confuse the sewage smell with that of ozone. Bombay started late and so had the advantage of the great body of research work that has been put into sewage purification in recent years. Much study preceded the choice of plant, and what appeared to be the best was chosen. Yet without the scientific staff and full laboratory facilities (in charge of Mr. Y. N. Kotwal) the institution of the works would have been a disaster for the city, the works being in a residential area. The special local conditions have demanded much study and adaptation to reduce stench and fly breeding. There is no lesson for the man of science in this, but there is one for the town and city councillor. Crude sewages look much alike, but in fact are vastly different and each new industry changes the character to some extent. Each type calls for study and research in local conditions if the best is to be got out of the plant. The authority should therefore not think that when system and labour are provided there shall be no further spending. Sanitation in any of its forms calls for constant scientific guidance and searching for improvements and economies.

Mr. Modak's closing words are worth repeating. "Sewage disposal is a universally repugnant subject and the public conclude that a sewage treatment plant cannot but be a place of foul odours and obnoxious sights, a place only fit for scavengers, a place that must be avoided by respectable persons. A well arranged, clean and landscaped sewage works with trees and lawns has a favourable psychological effect on the workers and visitors. The public will then know that, at a sewage treatment plant, even men, both clean and intelligent like themselves, are working, doing an important job and recovering useful products from human waste." The present writer visits one such place in Yorkshire where broad, gently curving walks are bounded with trees and easy seats, where there is no odour or annoyance from flies. There it is a pleasure to sit and restful to watch the spraying arms move slowly on their inevitable way.

ANTARCTIC RESEARCH

THE most recent volume of the Discovery Reports* contains a station list which is a continuation of that already published in the reports, vols. 1, 2 and 4, and gives particulars of the observations made by the R.R.S. *Discovery II* from October 1931 to April 1933. To the usual hydrological data are added, in part, phosphorus, nitrate plus nitrite, nitrite and silica estimates.

The porpoise described by J. E. Hamilton was in a practically skeletal condition and the paper relates to the skull, ribs, sternum and vertebral column.

* Discovery Reports. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Vol. 21 (1942). Title Page and List of Contents. Station List 1931–1933 (1941). A Rare Porpoise of the South Atlantic, *Phocæna dioptrica* (Lahille 1912) by J. E. Hamilton (1941). The Echiuridæ, Sipunculidæ and Priapulidæ collected by the Ships of the Discovery Committee during the Years 1926 to 1937, by A. C. Stephen (1941). Phytoplankton Periodicity in Antarctic Surface Waters, by T. John Hart (1942). (Cambridge: At the University Press.)

The Echiuridæ, etc., by A. C. Stephen has already been reviewed in NATURE (**149**, 57; 1942).

The remainder of the volume contains Dr. Hart's valuable monograph on Antarctic phytoplankton. Following his former work ("On the Phytoplankton of the South-West Atlantic and the Bellingshausen Sea, 1929–31", Discovery Reports, **8**; 1934) it amplifies this enormously, and the whole scope of the work during the earlier commission is greatly enlarged with the expansion of modern whaling during 1928–31, and after. His present work covers a vast area, his aim being to provide a picture of the major differences in phytoplankton distribution at different times of the year throughout the whole of the Antarctic zone of the Southern Ocean. It is very satisfactory that his earlier predictions have been in most cases fully confirmed.

This research, necessarily limited in scope, deals mainly with the larger qualitative and quantitative differences in the phytoplankton, at as many stations as possible, and the changes throughout the year in single areas where conditions seem to be typical. To facilitate this study the author divides the Antarctic zone into regions and special areas based mainly on the degree of neritic influence and the northward extent of the Antarctic surface waters in the longitudes concerned. The diatoms themselves, much the most important of the phytoplankton organisms, are grouped on a system taking into account their general distribution, seasonal and geographical.

Although a certain number of counts with centrifuged samples were made, by far the greater part of the work was done by the estimation of pigment contents of the catches by Harvey's (1934) method, the results being expressed in arbitrary colour units per cubic metre and the catches from 50 m. to 0 m. made with a vertical net fitted with a meter recording the volume of water filtered—a method which was found most effective.

Polar conditions extend much farther towards the equator in the southern than in the northern hemisphere and there are great differences in climate and hydrological conditions. Antarctic surface waters are much richer in nutrient salts and in phytoplankton. In corresponding latitudes the main increase is relatively later. Light, the degree of stability of the surface layers and the interrelated effects of pack ice, appear to be the most important factors in determining the course of phytoplankton production within the Antarctic zone, but the post-maximal summer decrease in the more northerly Antarctic waters and the very much greater production in neritic as compared with oceanic areas must probably be explained by chemical and biological factors. Here the reduction of silicate in the more northern parts of the Antarctic zone is a likely cause of decrease in diatoms, and the immense numbers of fæcal pellets of diatom-eating animals which accompany the comparatively poor phytoplankton during the decrease suggests that heavy grazing by the zooplanktonic herbivores was in part responsible and possibly the most important biological factor influencing production. The much greater richness of diatoms in the neritic areas as compared with the oceanic regions offers a different problem and here there may be, as suggested by Hardy, backed by a certain amount of evidence, the converse of grazing—that of animal exclusion. It is possible that the enormous masses of diatoms exclude the presence of zooplankton. To account for these huge masses of neritic diatoms recent work tends to show that extremely small amounts of organic

compounds, iron and manganese, derived from the land, exert a strongly favourable influence on phytoplankton production.

The importance of the pack-ice in maintaining the flora within the Antarctic zone is much emphasized. It is even more marked than earlier observations suggested. By means of the pack-ice neritic species are maintained very far from land and flourish for short periods when the ice disperses.

It is here confirmed, as is already noted by former observers (Marshall, Gross and others), that Calanoids are capable of triturating and swallowing the larger spiny diatoms as well as ingesting the smaller species entire. The author's examination of stomach contents showed that in addition to *Euphausia superba*, other Euphausiids, some of the most important Calanoids and some of the more abundant Pteropods, all feed extensively on diatoms.

INTERNATIONAL LAW AND MORALS

PROF. MORRIS GINSBERG wisely chose for his presidential address to the Aristotelian Society* a theme relevant both to his own distinguished work as a sociologist and to the world crisis which perforce dominates public attention at the present time. He sets himself to show how the trend towards an individualist doctrine in ethics is discernible also in recent developments of international law, attended there by "a certain lag in applying the criticisms which in the course of the nineteenth century were directed against the principles of individualism" (for example, the right of property and freedom of contract) in the internal economy of States, to the problem of the relations between States, a lag that is in no small measure responsible for our present international troubles and calls urgently for rectification. The only remedy, he contends (and the contention is supported by much judicious illustration), lies in the establishment of an effective supra-national authority. It makes little difference to this conclusion whether a utilitarian criterion or a doctrine of natural rights be adopted as the basis of the theory of international law; for the advocates of both these positions have carried the individualist interpretation to an extreme that precludes any satisfactory solution of international problems. Prof. Ginsberg's discussion of the concepts of equality, freedom and self-determination and of the difficulties provoked by each when held to be natural rights is perhaps the most masterly section of his address.

Three points in his review call for special notice. Not only is he convinced that the problem of international relations is a moral one; but it is so regarded by public opinion, both at home and, as has erroneously been questioned, in enemy countries. Nazi propaganda has won its way in Germany by an appeal to justice and denunciation of the alleged injustice of which Germany has been the victim. The theorists of the movement "even go to the length of claiming that they have bridged the gulf between law and morals and that their law alone is *richtiges Recht*". It is vitally important for us all to realize that the conflict in which we are engaged is being fought out on ethical terrain by both sides. It is a conflict of one set of moral principles against another.

Secondly, on both sides, the ethical concept of justice is in the forefront. Prof. Ginsberg follows Sidgwick in holding that the principle of seeking happiness needs supplementing by that of just distribution. So, again, there can be no peace among the nations without justice, and justice implies positive co-operation for common ends. Lastly, he has some interesting remarks towards the close on the error, into which many thinkers on politics have fallen, of presenting the issue now before the world as whether the individual exists for the State or the State for the individual. To posit the antithesis thus is to over-simplify the real problem. "There is clearly a need," he says, "for a great variety of corporate bodies to mediate between the mass of individuals and the community of mankind." This need is increasingly urgent in the larger among modern States, and is winning recognition in federal communities like the British Commonwealth, the American Union and the U.S.S.R. A great deal of the work of self-government is carried on, not within the bounds of constitutional machinery (where the individual citizen scarcely counts, even when he is voting), but through participation in non-official groups, churches, universities and learned societies, professional organizations and trade unions.

We are duly grateful to Prof. Ginsberg for directing attention to the part such groups may play in the solution of international problems.

W. G. DE BURGH.

*"The Individualist Basis of International Law and Morals", by Morris Ginsberg, being the Presidential Address to the Aristotelian Society, 1942–3.

CIVILIAN CONTRIBUTION TO EDUCATION IN H.M. FORCES

THE report of the Central Advisory Council for Adult Education in H.M. Forces for the period April–September 1942 reflects great credit on all the civilian authorities who constitute the Central Advisory Council. The launching of the educational scheme in the Forces could scarcely have been possible without the active participation of the Central Advisory Council, while any success it may have achieved is due in large measure to the substantial assistance provided by the regional committees of the Central Advisory Council in the various administrative areas. It is early yet to assess the real worth of this tremendous educational experiment, but already there is sufficient evidence to show that, by means of talks and discussions on various aspects of citizenship, those who have been responsible for the development of education in the Fighting Services have done much to develop a sense of civic awareness and responsibility among the people who are the potential citizens of Great Britain. Despite the difficulties of travelling in the black-out, the geographical isolation of Army and Air Force units, the cancellation of lectures at short notice owing to military exigencies and other factors which give rise to a considerable amount of exasperation and frustration, civilian lecturers have steadily continued to offer their services under the Scheme for Education in H.M. Forces. The statements in this report bear testimony to their achievements.

An analysis of the statistics brings out some interesting observations. During the period under review (April 1942–September 1942) the Central Advisory Council arranged some 44,695 single

lectures, 2,513 short courses (average, 5 meetings) and 1,030 continuous classes of longer duration (average, 13 meetings). A comparison of these figures with those of the preceding six months (29,970 single lectures, 1,785 short courses and 1,097 classes), indicates the progress of the scheme. It should be mentioned that these figures do not include lectures and classes arranged by local education authorities direct with the Services.

As one might expect, the greatest number of these lectures, etc., were given to Army units, but it is encouraging to note the increase in number of lectures to the Royal Air Force and the Navy. It is impossible to obtain accurate figures to show how much advantage is taken by the Women's Services of the regional committee facilities because there is no way of ascertaining the number of women attending in mixed audiences. But there is little doubt that the educational scheme has 'caught on' with the women auxiliaries, and this is clearly indicated by the figures set out in the report for all-women facilities.

A survey of the subjects which were discussed at these lectures and classes shows, as one might expect, the single lectures on current events are mostly in demand by the troops (29,419 out of a total 39,031). Science lectures are divided into two categories, vocational and non-vocational, and provided 264 and 2,287 lectures respectively; psychology is listed as a separate item and accounted for 493 lectures. There were 979 single lectures on arts subjects.

As in single lectures, current affairs were much the most popular choices in the short courses (1,664 out of 2,420), but the outstanding feature here is the interest shown in short courses on music (135 out of a total of 2,420). Among the classes, languages were mostly demanded (334 out of 970) while handicrafts (272) were also in favour. Vocational science classes were quite popular (131), but there was little demand for non-vocational science (12 classes only).

Some doubts are expressed as to whether the regional committees will be able to meet the increasing demands being made upon them. But for the time being, at least, this problem seems possible of solution by the more effective use of already existing panels of lecturers. The appointment of more full-time lecturers to the regional committees would do much to ease their difficulties.

CHEMICAL ATTACK UPON PESTS

IN time of war, man becomes pest- and disease-conscious. Under its abnormal and stringent conditions, leading to overcrowding and lack of vigilance, he, his domestic animals, his food plants, and to some extent his very clothing may become more susceptible to attack by pests and disease. War and pestilence interlock, but with increasing scientific knowledge we have ceased to regard the latter as an act of God before which we are powerless. Since the War of 1914–18, there has probably been a greater advance in the development of pest and disease control than in all past history. Much of this progress undoubtedly has been due to extensive and intensive co-operation of biologists and chemists. The early triumphs of chemotherapy gave an impetus to research outside the purely medical field, which was based upon the belief that in chemistry there existed a potential arsenal that might well be turned to account for purposes of pest control.

In a paper read before the Royal Society of Arts on March 31, Dr. R. E. Slade developed in the simplest language the story of the chemical methods now used for this purpose. Although almost any modern allotment holder knows the way, and possesses the means, of controlling many of the pests preying on his plants, a lecture of this type serves a most useful purpose in giving to the general public a co-ordinated account of a very large part of this field of research and in showing by implication how extensively and intimately it affects man's well-being. But surely Dr. Slade spreads his net too widely if "inconvenience to man" is to be specified as the main feature of a pest. Many birds may on occasion be an inconvenience in our gardens, but the species that rank as pests are few, and they detrimentally affect man's well-being. A dire word should surely be retained for grave ends.

It has frequently been stressed that most of the important insecticides and fungicides have been known for many years and that chemical research has added few to their number. Dr. Slade only in part answers this challenge, and confesses that chemists are finding the replacement of certain insecticides a formidable task. Many discoveries in all branches of science and industry have been due to chance, but their systematic improvement and development have been the result of strenuous and systematic research. The discovery of derris root in 1848 by Oxley was apparently a chance one, but its introduction to the Western world by Durham was the result of scientific research, its improvement resulted from years of selection research by Georgi and his co-workers in the Department of Agriculture in Malaya, and the structure of its active principles from the labours of a number of scientific men. Here one notes a feature which adds to the chemist's difficulties—the structural asymmetry of the insecticidal principles derived from plants, and the dependence of their very potent toxic action upon minute particulars in specific structures. The need at present, at least upon the research side, is a more intimate physiological knowledge of how these potent principles act. The co-ordination of effort between chemist, physicist and biologist, which Dr. Slade rightly stressed, needs carrying, and will be carried, a further stage.

Such a consideration is true in the fungicide field as well, but with a slightly different orientation. This field of work is closer in character to that of chemotherapy, and in the case of seed dressings and in the use of certain organic colouring matters as fungicides has at least benefited by the association.

Dr. Slade dealt only very shortly with the technical procedures used in the laboratory or the field for evaluating results. But to both of these much research has been devoted, and also to the statistical methods of analysing the data accumulated and stating their significance. It thus happens that whereas twenty-five years ago only a general personal impression of a roughly qualitative kind could be given of the relative merits of various chemical control measures, to-day, a degree of certainty which is at least as great as that obtained in the majority of biological experiments can be realized.

Dr. Slade's lecture was almost strictly impersonal in its outlook and dealt severely with facts; history, theory and generalization being eschewed. But such pioneers as H. E. Durham and J. D.

Gimlette, connected closely with the early introduction to general use of derris root, and that far-sighted planter Gilbert Walker, who first raised pyrethrum in Kenya, do deserve to be known and to be well thought of at this time. The encouragement given to researches on pest control by the Ministry of Agriculture and the Agricultural Research Council was justly emphasized, and there is abundant evidence at the present time that other official and public bodies are now fully aware of their importance for the preservation of stored produce, and for public health; there are, too, welcome signs of increasing consultation and co-operation between those who are carrying them out.

Definite advances in the use of the simpler organic chemical compounds as fumigants, contact insecticides and seed dressings have emerged in recent years; but one may feel a sense of frustration in that such compounds as hydrocyanic acid, lead arsenate, and Bordeaux mixture have not been completely replaced by equally efficient products, completely harmless to man. Yet there is satisfaction in feeling that so many organisms which are not only pests themselves, but also in many cases carry others still more pestiferous, are by the application of scientific method gradually being brought under control.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, June 5

ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY (at the Royal Institution, 21 Albemarle Street, London, W.1), at 4 p.m.—Prof. J. Yule Bogue: "Applied Photography": Miss K. C. Clark: "Indirect Radiography as applied to Medical Work": Dr. L. Mullins: "Miscellaneous Applications of Industrial Radiography": Mr. C. D. Reygsbach: "Sub-Standard Kine-Photomicrography": Mr. H. M. Ross: "The Photography of Photo-Elastic Stress Patterns".*

Monday, June 7

BRITISH SOCIAL HYGIENE COUNCIL (in the Hastings Hall, Tavistock House, Tavistock Square, London, W.C.1), at 3.30 p.m.—Extraordinary General Meeting. Reports of Enquiries on (1) "The Emotional Factor in Production": (2) "The Persistently Promiscuous and the Prostitute": (3) "Politics and Social Biology".

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 8 p.m.—Mr. Patrick FitzGerald: "Northern Marches of Yunnan".

Tuesday, June 8

TOWN AND COUNTRY PLANNING ASSOCIATION (at the Connaught Rooms, Gt. Queen Street, London, W.C.2), at 1 p.m.—Presentation of the Howard Memorial Medal to Prof. L. Patrick Abercrombie.

QUEKETT MICROSCOPICAL CLUB (at the Medical Society of London, 11 Chandos Street, Cavendish Square, London, W.1), at 7.30 p.m.—Prof. H. G. Jackson: "The Evolution of Terrestrial Invertebrates".

FREE GERMAN INSTITUTE OF SCIENCE AND LEARNING (at 16 Buckland Crescent, London, N.W.3), at 8 p.m.—Dr. H. S. Hopf: "Biology or Rassenlehre?—Considerations on a Vital Subject in the Curriculum".

Wednesday, June 9

INSTITUTION OF GAS ENGINEERS (at 1 Grosvenor Place, London, S.W.1), at 10 a.m.—80th Annual General Meeting; at 10.15 a.m.—Presidential Address by Mr. E. V. Evans.

Thursday, June 10

TOWN AND COUNTRY PLANNING ASSOCIATION (at 1 Grosvenor Place, London, S.W.1), at 1.15 p.m.—Mr. Raymond Evershed: "The Uthwatt Report".

Friday, June 11

ASSOCIATION OF APPLIED BIOLOGISTS (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 11.15 a.m.—Discussion on "Composts: their Preparation and Value".*

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Dr. Bryan H. C. Matthews: "Human Limits in Flight".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

GRADUATE OR EQUIVALENT IN ELECTRICAL ENGINEERING, a GRADUATE IN MATHEMATICS AND PHYSICS, and a well-qualified TEACHER OF ENGINEERING WORKSHOP PRACTICE AND ENGINEERING DRAWING, at the Bridgend Mining and Technical Institute—The Director of Education, County Hall, Cardiff (June 11).

HEADMASTER OF THE JUNIOR TECHNICAL SCHOOL OF ACTON TECHNICAL COLLEGE—The Secretary (T), Middlesex Education Committee, 10 Great George Street, Westminster, London, S.W.1 (June 14).

DEMONSTRATOR (MAN OR WOMAN) IN THE PHYSICS DEPARTMENT in London—The Warden and Secretary, London (Royal Free Hospital) School of Medicine for Women, Reed Hall, Streatham Drive, Exeter (June 15).

SENIOR LECTURER IN CHEMISTRY, and a SENIOR LECTURER IN PHYSICS—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham, Essex (June 16).

LECTURER IN THE DEPARTMENT OF MECHANICAL ENGINEERING—The Principal, Huddersfield Technical College, Huddersfield (June 16).

LECTURER IN VETERINARY PATHOLOGY—The Registrar, The University, Liverpool (June 18).

PSYCHIATRIC SOCIAL WORKER (FEMALE), non-resident, to co-operate with medical staff in investigating history and social welfare of mental cases—The Medical Superintendent, Durham County Mental Hospital, Winterton, Sedgefield, Stockton-on-Tees (endorsed 'Social Worker') (June 19).

DIRECTOR OF THE TRANSVAAL MUSEUM, Pretoria—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, London, W.C.2 (June 26).

LECTURER IN ANIMAL HUSBANDRY at the Imperial College of Tropical Agriculture in Trinidad—The Acting Secretary, Imperial College of Tropical Agriculture, Grand Buildings, Trafalgar Square, London, W.C.2 (June 30).

ASSISTANT ENGINEERS (4) IN THE DEPARTMENT OF POSTS AND TELEGRAPHS—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (July 2).

LECTURER IN THE ENGINEERING DEPARTMENT—The Registrar, Technical College, Cheltenham.

JUNIOR INSTRUMENT MAKER IN THE SURGICAL INSTRUMENT PRODUCTION DEPARTMENT, Government of India—The Secretary, Overseas Manpower Committee (Ref. 756), Ministry of Labour and National Service, Sardinia Street, Kingsway, London, W.C.2.

REFRACTORIES ENGINEER (with General Engineering training and particularly experience in Refractory Work, such as Retort Setting, Coke Oven Erection and Maintenance, including the Building of Kiln Linings, Chemical Brickwork and Furnace Work)—The Ministry of Labour and National Service, Central (Technical and Scientific) Register (Ref. C.1647X), Alexandra House, Kingsway, London, W.C.2.

LECTURER IN PHYSICS—The Clerk to the Governors, South-West Essex Technical College and School of Art, Forest Road, Walthamstow, London, E.17.

MASTER FOR CHEMISTRY—The Principal, County Secondary School and Cumberland Technical College, Workington.

JUNIOR SCIENTIFIC ASSISTANT (TEMPORARY) IN THE DEPARTMENT OF ECONOMICS—The Advisory Economist, Harper Adams Agricultural College, Newport, Shropshire.

PSYCHIATRIC SOCIAL WORKER—The Medical Superintendent, Springfield Mental Hospital, Tooting, London, S.W.17.

SECOND PSYCHIATRIC SOCIAL WORKER—The Medical Superintendent, Three Counties Mental Hospital, Arlesey, Beds.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Fortieth Annual Report, 1942–1943, of the Imperial Cancer Research Fund. Pp. 32. (London: Imperial Cancer Research Fund.) [194

Reports of the Council and Auditors of the Zoological Society of London for the Year 1942. Pp. 17. (London: Zoological Society of London.) [194

A Plan for Education. Pp. 16. (Cheltenham: National Union of Teachers, Toddington.) 1d. [194

Institute of Welding: Welding Research Council. Memorandum on Deep Penetration Butt Welding and Semi-Automatic Welder. (T. 10.) Pp. 4. (London: Institute of Welding.) [234

Other Countries

Brooklyn Botanic Garden Record. Vol. 32, No. 1: The Herb Garden of the Brooklyn Botanic Garden. Part 1: Culinary Herbs, their Culture, Traditions and Use, by Elizabeth Remsen Van Brunt; Part 2: Cooking with Herbs, by Virginia Riddle Svenson. (Guide No. 15.) Pp. 42. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [194

Annals of the Carnegie Museum. Vol. 29, Art. 14: New and Rare Ithomiinæ (Lepidoptera) in the Carnegie Museum. By Richard M. Fox. Pp. 397–403+1 plate. (Pittsburgh, Pa.: Carnegie Museum.) [194

U.S. Department of Agriculture. Circular No. 663: A Method of Estimating Reduction in Yield of Wheat caused by Hessian Fly Infestation. By C. C. Hill, E. J. Udine and J. S. Pinckney. Pp. 10. (Washington, D.C.: Government Printing Office.) 5 cents. [214